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THE administration of anæsthetics to patients who are suffering from pulmonary tuberculosis presents a problem which requires special consideration. Free and unobstructed respiration is considered to be essential in good anæsthesia of any kind. When the respiratory system is itself affected, the difficulties are much increased. The involvement of the lungs may vary both in intensity of infection and in extent of destruction, from a small chronic focus to a gross infection of an acute type. Further difficulties may have been introduced by induced pneumothorax, or by paralysis of the diaphragm from phrenic evulsion. The operation to be performed may vary in magnitude from the simple extraction of a tooth to any

major procedure in general surgery, or even to thoracoplasty for the treatment of the disease itself. In every case the general principles are the same; they should be carried out with meticulous care, or the result may be an exacerbation of the disease or even the death of the patient.

In choosing the anæsthetic for patients with pulmonary tuberculosis, the following essentials should be considered: (i) the agent, or combination of agents, should cause no irritation or damage to the lungs; (ii) the method employed should ensure adequate oxygenation; (iii) any general anæsthetic selected should allow rapid recovery of the reflexes, so that any sputum may be coughed up as soon as possible; (iv) the drugs used should neither raise nor lower the blood pressure to any pronounced degree; (v) agents which are apt to cause post-operative acidosis should be avoided as far as possible.

Operations Performed on 208 Patients and Anæsthetics Used.

Before preparing this paper I analysed 13,073 of my own anæsthetic records to find out the number

<sup>1</sup> Read at the fifth session of the Australasian Medical Congress (British Medical Association), August, 1937.

of patients suffering from pulmonary tuberculosis, the form of anaesthesia employed, the type of operations performed and the lessons to be learnt from the subsequent histories. Among these 13,073 cases were 208 in which the patients were suffering from pulmonary tuberculosis. The operations performed

TABLE I.

Types of Operations.	Number.
Dental operations	64
Operations on the ear, nose and throat	36
General surgical operations	53
Operations for treatment of pulmonary tuberculosis	55
Total	208

TABLE II.

Operations for Treatment of Pulmonary Tuberculosis.	Number.
Thoracoplasty	28
Thoracoplasty and phrenic evulsion	13
Phrenic evulsion	8
Abcess of the chest	2
Mobilization of apex of the lung	1
Pneumolysis and insertion of wax	1
Removal of wax	1
Exploration of chest and kidney	1
Total	55

on them are shown in Table I. Details of the operations for treatment of pulmonary tuberculosis are given in Table II. The anaesthetics employed are shown in Table III.

TABLE III.

Type of Anaesthesia.	Number of Operations.
Ethylene and oxygen	93
Ethylene and oxygen, with local	1
Ethylene and oxygen, endotracheal administration	29
Ethylene and oxygen, endotracheal administration and "Evipan"	2
Nitrous oxide and oxygen	20
Nitrous oxide and oxygen, with local	4
Nitrous oxide, oxygen and "Avertin"	2
Nitrous oxide, oxygen and "Evipan"	2
Nitrous oxide, oxygen and ether	4
Nitrous oxide and oxygen, endotracheal administration	10
Nitrous oxide and oxygen, endotracheal administration and "Evipan"	4
Ether, open method	2
Ether, endopharyngeal administration	2
Ether, endotracheal administration	4
Ether and "Avertin"	1
Ether preceded by intravenous injection of "Sodium Amytal"	1
Chloroform	5
Ethyl chloride, open method	2
"Avertin"	1
"Avertin" and local	1
Local	1
"Percain", spinal administration	4
"Stovaine", spinal administration	2
Caudal	1
Total	208

#### Complications.

Among these 208 patients were two who suffered from post-operative complications, which were probably directly due to the anaesthetic. Ether

was the anaesthetic in one case, and nitrous oxide, with the addition of a small quantity of ether, in the other.

CASE I.—Mr. A.W., aged twenty years, was apparently a healthy youth, except for sinusitis. Ether was administered by endotracheal insufflation for the performance of nasal antrostomy on the right side and of a Caldwell-Luc's radical operation on the left side, and for the removal of adenoids. His recovery was without unusual feature, and he left hospital on the seventh day. Three days later haemoptysis occurred twice, and he returned to hospital on the following day. On his being examined, crepitations were found over the whole of the right lung. The patient had a cough, with sputum which contained tubercle bacilli, and his temperature was raised at night. Pneumothorax therapy was instituted; he gradually recovered, and the disease was arrested in about eighteen months.

CASE II.—Mr. B., aged thirty-eight years, weighing 63.5 kilograms (140 pounds), was suffering from antral disease. He had previously had ether anaesthesia on two occasions for operations for a fractured skull. A history was given of pleurisy and occasional night sweats. He had a slight cough and the sputum had been sometimes tinged with blood. There were a few râles at the apex of the left lung; the night temperature was normal. The following premedication was given: paraldehyde, 16 cubic centimetres (four drachms), followed by morphine, 0.01 grammes (one-sixth of a grain), and atropine, 0.00065 grammes (one one-hundredth of a grain). Nitrous oxide and oxygen were administered. A small amount of ether was added in order to facilitate the passing of an endotracheal tube, after which the anaesthetic was maintained with nitrous oxide and oxygen alone. The narcosis was easy and without any straining or cyanosis. Caldwell-Luc's radical operation was performed on the right side. The patient recovered consciousness forty minutes after the operation and no vomiting occurred. Two days later he began to cough frequently, his temperature was raised, and tubercle bacilli were found in his sputum. The physical signs in his lungs were pronounced. Pneumothorax therapy was begun and recovery gradually took place.

It is obvious from these two cases that ether is definitely contraindicated in patients who are suffering from pulmonary tuberculosis; even a small addition of ether is not permissible. The anaesthetist has at his disposal a number of drugs and a variety of methods of administering them. Experience has shown that the best results will follow on certain lines.

#### Preparation of the Patient.

Comparatively few of the operations performed on phthisical patients are emergencies. Whenever possible, the operation should be postponed until treatment has improved the condition and so reduced the handicap. The patient should be in bed, absolutely at rest and on a high-calorie diet. He should be given abundant fluids and a sedative at night to ensure sufficient sleep, his resistance being thereby increased. Drastic purgatives and enemas should not be used unless a definite indication is present, as their dehydrating effect is certainly harmful. The room should be as near to the operating theatre as possible and should be connected with it by warmed corridors. The patient should be warmly clad, or even wrapped in cotton wool, so as to reduce shock to a minimum. The operating theatre should be really warm, from 21° to 24° C. (70° to 75° F.).

When the operation entails the opening of the pleura it is better to induce a pneumothorax some days earlier.

*Premedication.*

Premedication is useful in allaying the fears of the patient; it also has the advantage that, with the gaseous anaesthetics, it assists in obtaining a smoother and easier narcosis and allows the use of a higher percentage of oxygen.

The drugs employed should be chosen from those which do not unduly depress the respiration and which are eliminated quickly, so that the patient may be able to resume normal respiration and to cough up any secretions shortly after the operation is concluded. "Avertin", paraldehyde, "Sodium Amytal" and "Nembutal" are eliminated rather slowly, and should be reserved for patients whose disease is of the chronic fibrous type. "Evipan Sodium" has many advantages, as it is eliminated rapidly, does not unduly retard the recovery of consciousness and permits a high percentage of oxygen to be given. A satisfactory method is to give an injection of "Omnopon", 0.02 gramme (one-third of a grain), with scopolamine, 0.0004 gramme (one one-hundred-and-fiftieth of a grain) one hour before operation and then to produce basal narcosis with an intravenous injection of "Evipan Sodium" just before administering one of the gaseous anaesthetics. This technique usually allows the introduction of an endotracheal tube without the necessity of adding a lipid solvent anaesthetic. Of the drugs given by the mouth, the only one that I have found suitable is "Seconal". This barbiturate is absorbed in about twenty minutes and is eliminated very quickly.

*Methods of Anaesthesia Available.*

*Local Anaesthesia.*

The advantages of local and regional anaesthesia are that there is no irritation or damage to the lung, the cough reflex is not impaired, nor does post-operative vomiting or interference with metabolism occur. Less bleeding occurs than with inhalation anaesthesia.

The disadvantages are that the time required for extensive injections is considerable, delayed healing or even necrosis in a widely injected area is possible, the drug may have toxic effects, and the patient is conscious during the operation. After-pain is frequently greater than with inhalation anaesthesia.

Local anaesthesia may be used with advantage in certain operations, but in debilitated patients healing is definitely impaired by its use. Caudal anaesthesia is sufficient for certain operations in the perineal region, but fails in about 8% of cases.

*Spinal Anaesthesia.*

Spinal anaesthesia may be used in operations on the lower part of the body. It has also been used extensively for lower thoracoplasty.<sup>(1)</sup> It allows the cooperation of the patient and does not inhibit the cough reflex. Spinal anaesthesia is not advisable in very weak or debilitated patients, nor in those whose systolic blood pressure is below 100 millimetres of mercury. It is necessary to guard against

the possibility of anoxæmia when a high block is used; inhalation of oxygen may be required.

*Inhalation Anaesthetics.*

*Ethyl Chloride.*—Ethyl chloride is said to have no deleterious action on the lungs and may be used, by the open method, for operations which do not last for more than a few minutes. I have, however, seen a patient in whom an exacerbation of pulmonary tuberculosis occurred after the administration of ethyl chloride for dental extractions.

*Chloroform.*—Chloroform does no damage to the lungs, but is the most likely of any of the anaesthetics to cause post-operative acidosis. Its well-known toxic action on the liver and kidneys should prevent its use in long operations of any kind, especially on debilitated patients. It may be necessary to use it at times when better methods are not obtainable, or when the cautery or diathermy is employed. A very small addition of chloroform may sometimes be given with nitrous oxide and oxygen anaesthesia.

*Ether.*—Ether should not be used at all in the presence of pulmonary tuberculosis, either as the main anaesthetic or as an adjuvant to the gaseous anaesthetics. Many cases are on record in which the use of ether has precipitated acute lung disease.

*Vinyl Ether.*—Vinyl ether may be employed for short operations or as an adjuvant to the gaseous anaesthetics, as it does not irritate the respiratory mucous membrane. Increased salivation may occur, however, and this drawback may prevent it from being used in long operations.

*The Gaseous Anaesthetics.*—Nitrous oxide, ethylene and cyclopropane are particularly suited for use as the anaesthetics for patients suffering from pulmonary tuberculosis. With all of them the induction is rapid and pleasant, they are non-toxic, there is a total absence of respiratory irritation, very little change is caused in the blood pressure, and they do not cause post-operative acidosis. Anaesthesia may be prolonged for an operation of any duration. Recovery is rapid and usually without nausea or vomiting. The cough reflex is regained very quickly.

*Nitrous Oxide.*—Aeration may tend to be limited with nitrous oxide in those patients who have little remaining healthy lung tissue, but this may usually be overcome by some increase of premedication, or a minimal addition of chloroform or vinyl ether. The use of "Evipan Sodium" as premedication is particularly helpful in this respect. Nitrous oxide has a further advantage in that it may be employed when diathermy or the cautery is to be used, as it is non-inflammable.

*Ethylene.*—Ethylene allows a higher percentage of oxygen to be used and gives rather more muscular relaxation. It is, however, highly inflammable; it sometimes causes a rise of blood pressure and it is followed by a slightly greater amount of vomiting than nitrous oxide.

*Cyclopropane.*—Cyclopropane permits an exceedingly high percentage of oxygen to be given and

produces still better relaxation, but cannot be used in the presence of diathermy or cautery.

*Intravenously Induced Anaesthesia.*

Intravenously induced anaesthesia is popular at present and may be used with safety, provided that the quickly eliminated drugs are employed. "Evipan Sodium" or "Pentothal Sodium" alone is sometimes useful for short operations which last for a few minutes. They have both been employed also for long operations, injections being repeated when anaesthesia becomes light. There does not, however, appear to be any advantage in this proceeding over the use of the gaseous anaesthetics. Further research and experience may cause this opinion to be changed. The combination of "Evipan Sodium" with the gaseous anaesthetics is particularly valuable, as by this means the oxygen percentage may be greatly increased. With this technique it may sometimes be possible to give 55% of oxygen with nitrous oxide and 75% of oxygen with ethylene. During the inhalation of the gaseous anaesthetic the elimination of "Evipan Sodium" appears to be delayed, so that these high percentages of oxygen may be continued until the end of the operation. The "Evipan Sodium" is then quickly eliminated and the recovery of consciousness is delayed very little. "Pentothal Sodium" does not appear to be as useful as "Evipan Sodium" in combination with the gases, as it is eliminated too quickly.

*"Avertin".*—"Avertin" does not cause irritation or injury to the lungs, and may be given to phthisical patients. It is seldom wise to use it as the sole anaesthetic, as the anaesthetic dose is too close to the lethal dose. The blood pressure is decreased by "Avertin", and this drug should not be given to patients whose blood pressure is very low. Another disadvantage of "Avertin" is that unconsciousness is prolonged and respiration depressed; consequently it should not be used in cases in which it is important for the cough reflex to be active shortly after the operation is concluded. It is, however, sometimes useful as a basal narcotic in combination with the gaseous anaesthetics, in patients whose disease is of the chronic type or when the sputum is absent or slight in amount. Even in such patients it is wise to give an intravenous injection of "Cardiazol" or "Coramine" at the end of the narcosis, as they both have the power of hastening the elimination of "Avertin"—what has been termed "an awakening effect". The dose of "Avertin" for a patient suffering from pulmonary tuberculosis should usually be less than 0.1 cubic centimetre per kilogram of body weight. It is contraindicated when patients are very weak or toxæmic.

*Anesthetic Methods in Operations for Treatment of Pulmonary Tuberculosis.*

Anæsthetics in operations for treatment of pulmonary tuberculosis are specially hazardous. The patients themselves are those who have not responded to previous methods of treatment; frequently they are debilitated and have pyrexia, cough

and sputum. Cavities may be present which it has been impossible to obliterate by artificial pneumothorax. Moreover, a pneumothorax or oleothorax is frequently present.

*Thoracoscopy and Division of Adhesions.*—Local anaesthesia, with suitable premedication, will usually suffice for thoracoscopy and division of adhesions, but in very nervous patients it may be necessary to cause unconsciousness. Nitrous oxide and oxygen must be used on account of the danger of explosion with ethylene or cyclopropane. It does not seem justifiable to use chloroform for long operations or to give it to very debilitated patients.

*Phrenic Evulsion.*—Phrenic evulsion is much easier to perform under one of the gaseous anaesthetics than under local infiltration anaesthesia. The position and manipulations are distressing to a conscious patient.

*Thoracoplasty.*—For thoracoplasty one of the gaseous anaesthetics should be used. Cyclopropane is probably the best on account of the very high percentage of oxygen that can be employed. If, however, the surgeon wishes to use diathermy for the arrest of haemorrhage, the gas must be nitrous oxide. Whichever gas is given, the carbon dioxide absorption technique is preferable, as by this method the breathing is quieter and the respiratory excursions are lessened. A well-fitting face mask will suffice for many patients, but it is sometimes difficult to avoid gas leakage in thin, edentulous patients. To overcome this difficulty it may be advantageous if the patient wears a full set of artificial teeth, or if a Shipway's airway which has an inflatable rubber bag is used. Endotracheal methods of induction are preferable in certain cases; either a Magill's tube (the pharynx being packed with a vaseline bandage) is used, or a catheter with an inflating collar, or a Guedel's plug. Endotracheal anaesthesia makes the control of the patient much easier in the position in which he is placed for this operation. Whatever method is used, the gas apparatus should be capable of giving the gases under pressure or of inflating the lungs with oxygen.

Spinal anaesthesia may be used for operations involving the lower ribs, according to the method of Shields,<sup>(1)</sup> who uses "Procaine" dissolved in cerebro-spinal fluid, and that of Magill,<sup>(2)</sup> who uses "Percain" given by the Howard Jones technique.

*Conclusions.*

In operations on patients suffering from pulmonary tuberculosis the following general considerations regarding anaesthesia are important.

1. The gaseous anaesthetics are the most generally suitable.
2. "Evipan Sodium" is useful as a basal narcotic.
3. Spinal anaesthesia is valuable in certain cases.
4. Ether should not be employed.

*References.*

<sup>(1)</sup> H. J. Shields: "Spinal Anesthesia in Thoracic Surgery", *Anesthesia and Analgesia*, Volume XIV, Number 5, September-October, 1935, page 193.

<sup>(2)</sup> I. W. Magill: "Anesthesia in Thoracic Surgery, with Special Reference to Lobectomy", *Proceedings of the Royal Society of Medicine*, Volume XXIX (Section of Anæsthetists), April, 1936, pages 7 to 18.

EXPERIENCES WITH "PENTOTHAL SODIUM".<sup>1</sup>

By GILBERT BROWN, M.B., B.S., D.A. (R.C.P. and S., England).

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Honorary Anæsthetist, Perth Hospital, Perth.

THROUGH the courtesy of Messrs. Abbotts Limited we were given a number of ampoules of "Pentothal Sodium" for clinical trial. The series of cases quoted is small—56—but the indications for intravenously induced anaesthesia are not frequent.

Fifty-one of the patients were given a 10% solution, as originally recommended, and five only the 5% solution more recently suggested. Apparently the weaker strength is now laid down as the correct one to obviate the intense local irritation of tissues and the occasional sloughing that result if any of the solution is inadvertently injected into the perivenous tissue.

The relevant details of the series are as follows: the ages of the patients varied from fifteen to eighty years; thirty-nine were males and seventeen were females; the dosage varied from three to twelve cubic centimetres of the 10% solution and from four to twelve cubic centimetres of the 5% solution.

The longest recorded time of effective anaesthesia without any adjuvant was twenty-five minutes. The patient was a male, aged fifty-four years, who was undergoing open reduction of fracture of the clavicle, and ten cubic centimetres of the 10% solution were used; 0.011 gramme of morphine (one sixth of a grain) and 0.00065 gramme (one one-hundredth of a grain) of atropine were used as premedication. After twenty-five minutes the patient began to grow restless, and in order to avoid the injection of further quantities the operation was completed under anaesthesia with nitrous oxide and oxygen.

Adjuvant anaesthesia was used in twelve out of the fifty-six cases, but in some of these twelve the "Pentothal Sodium" was used for induction purposes only.

No premedication was used in some cases. The premedication used in the remainder included "Allonal", "Nembutal", "Avertin", morphine, hyoscine and atropine.

The types of operation performed in the fifty-six cases were the following:

Type of Operation.	Number.
Dental	17
Ophthalmological	10
Urogenital (cystotomy, dilatation of strictures, radical hydrocele, drainage of perinephric abscess)	6
Abdominal (appendicectomy, cholecystectomy et cetera)	4

<sup>1</sup> Read at the fifth session of the Australasian Medical Congress (British Medical Association), August, 1937.

Orthopaedic (manipulation, amputation et cetera)	5
Rectal (haemorrhoidectomy, excision of fistula, sigmoidoscopy)	3
Radical mastectomy	2
Antrostomy	2
Esophagoscopy	1
Diathermy of tongue	1
Minor surgery (incisions et cetera)	5
Total	56

The four patients undergoing abdominal operations, with the exception of one, who was being subjected to laparotomy, all had adjuvant anaesthesia.

Adjuvant anaesthesia was used in both radical mastectomies.

Severe sloughing occurred in two cases in the region of the site of injection. In both it resulted from the use of a 10% solution. Extreme salivation occurred in one case in which preliminary medication had not been used. There were no deaths in the series.

#### Comments.

No definite conclusions can be arrived at from so small a series, but the following comments are made.

1. Compared with "Evipan", the induction of anaesthesia with "Pentothal Sodium" appears to be quicker and quieter and the tendency to jactitation seems to be lessened. On the other hand, "Evipan" seems to be eliminated more slowly than "Pentothal Sodium", hence the patient is less likely to "come out" of basal narcosis with the former before he is under the influence of the adjuvant.

2. Patients almost unanimously say that the induction is without any unpleasant sensation, and practically no post-anaesthetic vomiting occurs. From this point of view, therefore, it would appear to have a definite indication in short operations in the good-risk class of patient. This feature has perhaps its greatest application in short eye operations under general anaesthesia. The quiet respiratory movements and the absence of post-anaesthetic vomiting are often of paramount importance to the ophthalmic surgeon.

3. The 5% solution is recommended to eliminate the possibility of severe tissue irritation in the event of any being spilt extravenously. The larger syringe (twenty cubic centimetres' capacity instead of ten cubic centimetres) is, however, technically more clumsy to handle when the solution is being given by the repeated dosage method. This feature can be overcome by using the Dickson Wright or Abel apparatus.

4. The excessive salivation met with in one patient who had been given no premedication suggests at least the injection of atropine before the induction of anaesthesia. The addition of a small dose of morphine or of a barbiturate appears to add no risk and will probably allay apprehension to a certain extent.

5. The indications for intravenously induced anaesthesia are necessarily very limited, but when the need arises "Pentothal Sodium" seems to be worthy of serious consideration.

CYCLOPROPANE ANAESTHESIA.<sup>1</sup>

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Prince Alfred Hospital, Sydney.*

## Historical.

Of all the advances in anaesthesia that have taken place since the discovery of anaesthetics nearly one hundred years ago, none has been of greater value than the introduction of cyclopropane. Its properties as an anaesthetic were first described, in 1929, by Lucas and Henderson,<sup>(1) (2)</sup> of Toronto, Canada. Remaining obscure since its preparation and study by Freund, in 1882, its re-emergence was the outcome of investigations into the toxicity of propylene when used for anaesthesia. Animal experiments indicated that cyclopropane had unusual possibilities, and the experimental and clinical researches of Waters and others<sup>(3) (4) (5)</sup> demonstrated its extraordinary superiority in many respects over other agents. Extensive clinical experience has since confirmed these findings, its use now being widespread and rapidly extending. Griffith,<sup>(6) (7) (8)</sup> of Montreal, initiated its clinical use in Canada, and Muir,<sup>(9) (11)</sup> of Cape Town, introduced it to England, where Sykes<sup>(10)</sup> and Rowbotham<sup>(11) (12)</sup> continued its investigation and further described its clinical application. Bourne,<sup>(13)</sup> of Montreal, describing its uses in obstetrics, enjoys early precedence in English medical literature. In the United States of America especially, a large and increasing volume of literature on it is accumulating, comprising extensive descriptions of both its general and special applications, and emanating largely from authorities well qualified to assess its value.

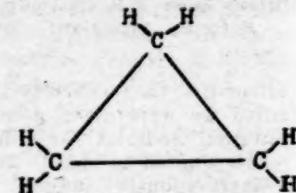
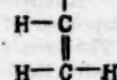
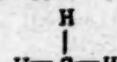
The honour of its introduction to Australia belongs to Hayward and Troup,<sup>(14)</sup> of Perth, Western Australia, and these workers are to be congratulated for such valuable pioneering, involving as it does much trouble and no little expense. One of us (H.J.D.) first used it in Sydney, in 1936, since when a steadily increasing experience is confirming our originally favourable opinion and sustaining our enthusiasm. A preliminary report, chiefly directed to the dissemination of elementary information, has already been published here.<sup>(15)</sup>

## Chemistry and Physical Properties.

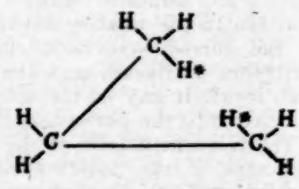
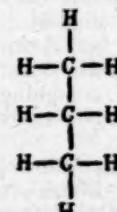
Cyclopropane, or trimethylene, is a gas, and is an isomer of propylene, each having the formula  $C_3H_6$ . Propylene, however, is the second member of the

olefine or ethylene series of unsaturated hydrocarbons, while cyclopropane, as its name implies, has a cyclic molecule and is more closely related to propane ( $C_3H_8$ ). The following structural formulæ illustrate these points:

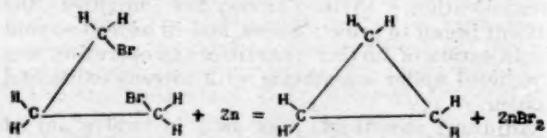
Propylene ( $CH_3.CH:CH_2$ ). Cyclopropane ( $CH_3.CH_2.CH_3$ ).



Propane ( $CH_3.CH_2.CH_3$ ) may be represented by either of the two structural formulæ shown below:



It will be seen that by removing two hydrogen atoms (\*) from propane and closing the ring the formula for cyclopropane is made. Production on this basis from the propane of natural gas is at present on trial, the formation of trimethylene chloride or 1,3-dichloropropane being an intermediate stage.<sup>(16)</sup> Essentially the same process occurs in the usual method of preparation by the reduction of trimethylene bromide ( $CH_2Br.CH_2.CH_2Br$ ) in alcoholic solution by the agency of metallic zinc. This is shown in the following formula:



Cyclopropane is heavier than air, its density being 1.46. Its molecular weight is 42.05. Only slightly soluble in water, it has a high affinity for oils and lipoids, the oil-water solubility ratio (generally accepted as indicating anaesthetic potency) being 34.3 : 1.<sup>(17)</sup> Its odour is pungent but not unpleasant, and it is irritating to inhale in very high concentrations only.

It is liquefied at 70° F. by a pressure of only 75 pounds per square inch, and so may be supplied in small, thin-walled cylinders. No polymerization or spontaneous disintegration occurs in this process. Like other compressed gases, it retains its purity indefinitely, thus contrasting with liquid agents and solutions, which are subject to deterioration on exposure to light and air. Cyclopropane is a solvent for rubber and rubber compounds, and, although such action is not manifest in the low concentrations

<sup>1</sup> Read at the fifth session of the Australasian Medical Congress (British Medical Association), August, 1937.

used for anaesthesia,<sup>(18)</sup> the gas will diffuse to an appreciable extent through rubber bags, skin *et cetera*. This property accounts in some measure for losses of the gas during administration.

Cyclopropane is inflammable, and when it is mixed with oxygen the explosive range is from 2·5% to 50%;<sup>(18) (19)</sup> the handling of concentrations suitable for anaesthesia thus requires care. Such mixtures, however, are no more dangerous in this regard than is the commonly used combination of nitrous oxide, oxygen and ether. Otherwise cyclopropane is almost inert chemically.

#### Pharmacology.

Cyclopropane enters and leaves the body unchanged, and it has remarkably slight effects on metabolic processes, even after prolonged and repeated administration. The hydrogen ion concentration, carbon dioxide combining power, and non-protein nitrogen content of the blood plasma are virtually unaffected, and there is a trifling rise only in the blood sugar level.<sup>(1) (2) (5) (20)</sup> As is the case with other agents, there are considerable mobilization and excretion of muscle phosphate, and the usual leucocytosis of anaesthesia occurs.<sup>(5)</sup> Little alteration of the blood volume develops, there being no relative increase of cellular constituents from loss of fluid to the tissues or from splenic contraction.<sup>(5)</sup> Restoration of the normal state is rapid, being complete within a few hours of the administration.

No demonstrable liver damage is produced by cyclopropane, and there is no aggravation of that previously established by chloroform poisoning or eclampsia.<sup>(21)</sup> Renal function, even if previously impaired, suffers no alteration, and, although the occurrence of transient anuria during anaesthesia has been described,<sup>(5)</sup> it seems to be very uncommon.

Owing to the affinity of cyclopropane for lipoids and fatty tissues, saturation proceeds more rapidly than with other agents, but is incomplete even after prolonged anaesthesia.<sup>(22)</sup> The depth of anaesthesia varies with the concentration of the gas in the blood. In the maintenance of this concentration periodical additions are necessary to compensate for losses to the tissues and elsewhere, especially in the earlier stages of the administration. In dogs, light anaesthesia requires a concentration of 18 volumes *per centum* in the atmosphere and of 13·9 milligrammes *per centum* in the blood; deep anaesthesia (respiratory arrest) requires 35·8 volumes and 28·2 milligrammes *per centum* respectively.<sup>(23) (24)</sup>

Clinically, fairly wide variations are found to exist in the atmospheric concentrations required for producing the different stages and planes of anaesthesia. Accurate determinations are unnecessary, dosages being regulated at all times in accordance with the reactions of the patient. Average figures are as shown below:<sup>(5)</sup>

Stage.	Concentration.
Third stage—surgical anaesthesia—	
Plane I (relaxation of lid and loss of conjunctival reflex)	7·4%
Plane II (cessation of eyeball movements)	13·1%
Plane III (progressive intercostal paralysis)	23·3%
Fourth stage—respiratory arrest	42·9%

Anæsthesia is usually quite adequate with concentrations not exceeding 25%, and the potency of the gas is such as to make possible the occurrence of circulatory failure and death even in the presence of excess of oxygen.<sup>(18)</sup> This is in marked contrast to nitrous oxide and ethylene, with which oxygen deprivation is necessary in the production of deep anaesthesia.

The signs of anaesthesia parallel those of other agents; but their recognition is less easy with cyclopropane since its flexibility, that is, the facility with which blood concentrations may be varied, allows rapid transitions between the different planes. Those of chief value are: lid relaxation and disappearance of the conjunctival reflex, progressive abolition of eyeball movements, and the character of the respiration and pulse.<sup>(25) (26)</sup> Pupillary signs are of little assistance, dilatation not occurring until great depth of anaesthesia is reached.

The inhalational is the only practicable method for the administration of cyclopropane.<sup>(27)</sup> As the drug is non-irritant in concentrations suitable for anaesthesia, and as oxygen deficiency does not occur, respiratory stimulation is absent if carbon dioxide accumulation is prevented.

There appears to be a preponderance of parasympathetic activity during cyclopropane anaesthesia, indicated by the tendency to salivation, lachrymation and mucous secretion, the contracted pupil and bowel, and the bradycardia, in the control of which preliminary administration of atropine or hyoscine is of great value.<sup>(4) (5)</sup> This is in marked contrast to the hyperadrenalinæmia and sympathetic hyperactivity which are seen in anaesthesia with ether,<sup>(28)</sup> and even with nitrous oxide and ethylene, when oxygen deficiency, especially if prolonged, is necessarily existent. These are potent factors in the mobilization of muscle and liver glycogen, and in the production of intestinal atony, effects not seen in cyclopropane anaesthesia.

With too high concentrations toxic effects on cardiac musculature arise, manifested by the development of arrhythmias, bradycardia, and tachycardia. Ventricular fibrillation has been noted as the terminal feature.<sup>(1) (2) (4) (5)</sup> This illustrates the need for care and skill in administration, and emphasizes the possible danger of the concurrent use of adrenalin. Electrocardiographic studies show that these phenomena are common to all forms of anaesthesia.<sup>(29)</sup>

As in anaesthesia with other gaseous substances, increased capillary bleeding is sometimes noticed in cyclopropane anaesthesia. As there is no alteration in the bleeding time or coagulation time of the blood,<sup>(5)</sup> this bleeding probably arises from the more nearly normal state of the circulation when these agents are used, the need for an increased peripheral resistance, directed to the maintenance of the blood pressure, not arising. In cyclopropane anaesthesia the blood, both arterial and venous, is always highly oxygenated;<sup>(17)</sup> this may lend emphasis to the impression of increased oozing. Such hyperoxygénéation itself may possibly be a causative factor;

but the most likely explanation is that an unsuspected rise in blood pressure is responsible.

Observations on the blood pressure during cyclopropane anaesthesia show maintenance at almost normal levels even during prolonged administrations. A fall will occur if excessive depth is produced or if blood loss becomes severe. Some observers describe a rise as being characteristic;<sup>(12)</sup> but opinions differ as to whether cyclopropane itself is the cause. Carbon dioxide accumulation is undoubtedly a factor,<sup>(13)</sup> due either to imperfect absorption by the soda-lime or to minor grades of respiratory obstruction, or to resistance or to excessive dead space in apparatus of faulty design, all of which hinder gaseous exchanges.

#### Technique of Administration.

The use of the carbon dioxide absorption technique is essential to the successful and economical administration of cyclopropane. Granulated soda-lime is at present the most satisfactory absorbent available. Suitable apparatus, incorporating accurate flow meters for regulating the various gas supplies, is a further essential, and the absorption attachments should provide for an alternative supply of fresh soda-lime, of immediate availability. All valves, orifices, passages *et cetera* should offer minimal resistance to the excursions of the enclosed gases.

The system, being entirely closed, represents an extension of the patient's respiratory tract, containing an atmosphere which is breathed over and over again. The application of this principle is rendered possible by the fact that the anaesthetic agent is absorbed and excreted unchanged, while carbon dioxide is the only waste product of any significance eliminated by the lungs. Oxygen must be continuously supplied in amounts sufficient to meet metabolic requirements, its flow usually ranging between 200 and 500 cubic centimetres per minute.

Some further advantages of the closed system are that both heat and moisture are conserved, and desiccation of mucous surfaces is prevented. The risk of ignition is greatly reduced by the enclosed state and high humidity of the gas mixture, a further safeguard being in the necessary prevention of external leakages. Such leakages, diffusion, and the gradual saturation of body tissues, necessitate small replenishments of cyclopropane, especially in the earlier stages of the administration. If relaxation is imperfect, chloroform, ether, or vinyl ether may be added to the mixture, their toxic effects being minimized by the high oxygen concentration.<sup>(30)</sup> There are two outstanding types of absorption apparatus, the Waters to-and-fro<sup>(31)</sup> and the Sword circle system.<sup>(32)</sup>

Details of technique vary considerably with different workers. Light premedication with morphine and atropine, or hyoscine, in doses not exceeding 0.015 grammie (one-quarter of a grain) of morphine nor 0.0006 grammie (one one-hundredth of a grain) of atropine or hyoscine, is essential.<sup>(4)(5)</sup> Other premedicating agents, such as "Avertin"<sup>(27)</sup> or the barbiturates, may be used; but full basal

narcosis is generally undesirable owing to the associated respiratory depression, evident both during and after operation, and involving a greatly increased incidence of pulmonary complications.<sup>(33)</sup> Complete preliminary narcosis is justifiable only with rapidly eliminated agents like "Evipan Sodium" or "Pentothal Sodium", the effect of which will have passed away by the time anaesthesia ends. It is not so much the situation during administration that demands this caution as the prospect of prolonged post-operative depression, especially as the patient shall have become habituated to an atmosphere rich in oxygen.

Our own practice, using the closed circuit method, is first to inflate the rebreathing bag with oxygen to a degree sufficient to accommodate the patient's respiratory excursions. The mask is then apposed to the face and an oxygen inflow of 250 to 300 cubic centimetres per minute begun. Cyclopropane is then run in for one to five minutes at a rate of 500 cubic centimetres per minute until surgical anaesthesia is established.

If considered necessary, an artificial pharyngeal airway is inserted; light packing of the cheek pouches with gauze at this stage greatly facilitates close apposition of the mask, especially in edentulous patients. The mask is now replaced and fixed firmly with a head harness, and control is regained by the admission of fresh gas in appropriate amounts. Thereafter additions of gas may be intermittent or continuous, the latter being preferable in the early stages, to compensate for tissue distribution and other losses. An inflow of from 50 to 150 cubic centimetres per minute during the first 15 to 20 minutes of the administration is suitable, after which occasional small replenishments are required.

Tracheal intubation is performed if necessary, either transnasally or transorally, a wide-bore Magill tube being used. When the laryngoscope is used it is advisable to add some ether to the mixture to ensure sufficiently prolonged relaxation of the jaw. Alternatively, and chiefly for reasons of economy, induction may be effected with the ethyl chloride and ether sequence, and maintenance conducted with the gas mixture after intubation has been performed. Leakage is prevented by a pharyngeal pack of gauze lightly soaked in paraffin oil or by a Guedel-Waters inflatable cuff on the tube.

Carbon dioxide absorption is usually begun once adequate depth has been attained, and thereafter is continuous or intermittent, as indications vary. Sometimes it is necessary from the beginning of or early in induction. It cannot be too strongly emphasized that hyperpnoea is unnecessary and even inadvisable for hastening induction. Dangerously high blood concentrations of cyclopropane are thereby developed, tending to respiratory arrest and the early onset of cardiac arrhythmias, while the subsequent establishment of steady control is made more difficult.

Excessive depth, with consequent respiratory depression, should never be made to mask

inadequate carbon dioxide absorption. The efficiency of soda-lime gradually decreases with use; but even when it is clinically exhausted analysis will show it to be only about 50% saturated,<sup>(34)</sup> its superficial portions only being effective. Inevitably a stage must be reached when the area available for absorption becomes inadequate, or it may be so from the outset in cases of high metabolic activity, the container being too small. In such circumstances hyperpnoea and a rise of blood pressure will occur; the former may be interpreted as a sign of lightness and may lead the anaesthetist to increase the anaesthetic concentration. This depresses the increased respiratory activity and masks the raised blood pressure, which imposes an unnecessary strain on the myocardium and possibly aggravates capillary bleeding. Such a situation is likely to result in alarming respiratory and circulatory depression after the anaesthetic, because the strong stimulus, originating in the hitherto raised carbon dioxide tension, is suddenly removed.

Induction of anaesthesia with cyclopropane is quiet and pleasant; excitement and struggling are rare; dreams and the sensation of smothering are absent.<sup>(27)</sup> A well-conducted maintenance is extremely placid and devoid of alarms, no other form of anaesthesia more nearly resembling natural sleep. The skin is dry and warm, the colour excellent, and muscular relaxation good. Respiration is quiet and unlaboured. The speed of recovery largely depends on the amount of premedication and the duration of anaesthesia, and while not so rapid as with nitrous oxide, is quite fast. Transient restlessness sometimes occurs during recovery.

#### **Special Indications.**

While cyclopropane anaesthesia is suitable, with very few exceptions, for the whole range of surgery, there are certain circumstances in which it is invaluable. For the sake of brevity these are tabulated as follows:

1. Metabolic disturbances.
  - Thyreotoxicosis.<sup>(18)(28)</sup>
  - Diabetes.<sup>(20)</sup>
  - Severe toxic states and pyrexias.
  - Surgery of infants and children.<sup>(6)</sup>
2. Thoracic surgery.<sup>(18)(28)(29)</sup>
  - Lobectomy.
  - Pulmonectomy.
  - Gesophagectomy.
  - Thoracoplasty.
  - Diaphragmatic hernia.
3. States of debility and cachexia.
  - Old age.
  - Starvation.
  - Advanced renal and hepatic disease.
  - Anæmias.<sup>(29)</sup>
  - Malignant disease.
  - Tuberculosis.
4. States of impaired vital capacity and respiratory obstruction.<sup>(29)</sup>
  - Posture, especially in thoracic surgery.<sup>(29)</sup>
  - Malignant thyroid disease.
  - Mediastinal tumours.
  - Lung diseases in general.
  - Abdominal effusions and tumours.

5. Circulatory inefficiency.
  - Heart diseases in general.
  - Pericardial effusions.
  - Shock.<sup>(18)</sup>
  - Severe haemorrhage.
6. Obstetric surgery.<sup>(20)(28)(29)(30)</sup>
  - Cæsarean section.<sup>(29)</sup>
  - Post partum haemorrhage.

#### **Contraindications.**

The inflammability of cyclopropane and its tendency to be associated with a rise of blood pressure and increased capillary bleeding are the chief contraindications to its use. As with other agents, advantages and disadvantages must be assessed, limitations recognized, and the choice determined by the weight of evidence. Judicious use of suitable premedicating agents and adjuvants, good apparatus and technique, and experience, will favour wider scope. The use of flame, cautery or diathermy, neurological surgery, and surgery involving extensive dissections (breast, glands of the neck) are the chief contraindications. They are by no means absolute and will operate with decreased frequency as technique improves.

#### **Complications.**

It is generally agreed that the incidence of complications both during and after the administration of cyclopropane is less than when other agents are used. The relatively complicated apparatus and technique, and the need for experience in their use, introduce possibilities of difficulty, but at the same time provide greater facilities for dealing with any emergencies that may arise.

#### *Complications during Anaesthesia.*

**Laryngospasm.**—Laryngospasm has occurred in about 5% of our cases. Although it is described as occurring only when excessive gas concentrations are used,<sup>(5)(27)</sup> lightness, coupled with surgical stimuli, seems to be a responsible factor. The onset is usually gradual and may occur during traction or some exploratory manoeuvre. Once established, laryngospasm is apt to be extraordinarily persistent, and while rarely causing absolute obstruction, will impede greatly the gaseous exchanges. Efforts to control it often result in the development of excessive gas concentrations, which may aggravate the spasm. Thus temporary dilution with oxygen will often relieve it, after which adequate depth must be reattained before the operation proceeds. If it is intractable, the passage of a wide-bore Magill endotracheal tube is the best remedy, and this is a desirable precaution whenever the head is likely to be inaccessible during the course of the operation.

**Capillary Bleeding.**—Capillary bleeding is more frequent than in anaesthesia with ether or chloroform; occasionally it is severe, efforts to secure haemostasis delaying the progress of the operation and sometimes even aggravating the condition. Usually it may be to a large extent ignored, since it seems invariably to cease with the termination of anaesthesia. Alternatively, either chloroform or ether may be added for the sake of its depressant effects on the circulation while its grosser toxic

effects are avoided by virtue of the hyperoxygenation available.<sup>(39)</sup>

**Shock.**—Low toxicity and high potency, permitting free oxygenation, reduce the incidence of shock during cyclopropane anaesthesia. The effects of excessive blood loss, however, either from free haemorrhage or insidious oozing, and especially in the debilitated or anaemic, may easily be overlooked owing to the good colour and generally satisfactory condition of the patient. The sudden withdrawal of the warm, moist, oxygen-rich atmosphere at the end of the operation may disclose a quite unsuspected state of depression, which may be guarded against only by careful observations throughout the administration.

**Cardiac Irregularities.**—Cardiac irregularities are always transient, no case of their permanent or persistent establishment, attributable to the anaesthetic, having been recorded.

**Respiratory Depression.**—Respiratory arrest is not of such moment as when other agents are used: it rarely assumes the proportions of an acute emergency. Even relatively prolonged apnoea is permissible if intermittent passive respiration (by bag compression) is employed, the oxygen excess providing a wide margin between respiratory arrest and cardiac failure.<sup>(40)</sup>

#### Post-Operative Complications.

So far only one extensive comparative study of complications following the use of cyclopropane and of other agents is available,<sup>(41)</sup> there being 2,200 cases in each series. This shows an extraordinary reduction in pulmonary complications after cyclopropane anaesthesia, especially in extraabdominal work. Comparative figures for early as opposed to remote post-operative mortality are very much in favour of cyclopropane.<sup>(42)</sup>

Minor circulatory complications are somewhat increased after cyclopropane anaesthesia.<sup>(41)</sup> While cardiac arrhythmias occurring during administration are transient, bradycardia or tachycardia may persist for a time afterwards. Shock and a fall in blood pressure occur slightly more frequently; but to what extent the selection of cyclopropane for poor risks influences these results is obscure.<sup>(5)</sup> It is possible that the sudden transition from an artificial to the natural atmosphere involves some risk in this respect, so that it is advisable to practice air dilution of the gas mixture towards the end of the administration, during which perfect carbon dioxide absorption is essential, for reasons already stressed.

Nausea and slight vomiting are common after cyclopropane anaesthesia, their incidence being less than after ether and higher than after nitrous oxide anaesthesia. Severe vomiting is very rare. The occurrence of post-operative intestinal atony is definitely reduced, and evidence of hepatic damage is absent. Urinary retention is no more frequent than usual, and the less common sequelae of anaesthesia, such as embolism, thrombosis, mental changes *et cetera*, are extremely rare with cyclopropane. It is probable that increasing experience with it will result in improved figures for complications in general.

#### Conclusions.

Our experience with this new agent is as yet limited, only 120 administrations having been completed by us; but we feel justified in recording our favourable opinion of it. Fortified by contacts with Waters, Griffith, and other workers in the United States of America and Canada, whose work highly impressed us, we ventured to use cyclopropane with a considerable degree of confidence, which subsequent experience has enhanced. Many problems associated with the administration are still unsolved, and the final evaluation awaits determination; but it seems that cyclopropane has an assured place in the field of anaesthesia. For the present its use must remain in the hands of those specially qualified by the possession of experience and suitable facilities. The apparatus involved is expensive and requires careful handling, and minute attention to details of physiology, ordinarily not considered of primary importance, is essential. Despite these complications, the advantages gained outweigh the disadvantages, which, with an improved conception of the scope and limitations of cyclopropane, should become less frequently apparent.

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#### ANÆSTHETIC FATALITIES.

At a meeting of the Section of Anæsthetists at the fifth session of the Australasian Medical Congress (British Medical Association), held at Adelaide in August, 1937, there was a discussion on deaths of patients under anesthesia. The statistics were presented in tabular form, as set out on the following pages.

#### The Alfred Hospital, Melbourne.

DR. GEOFFREY KAYE presented statistics showing the numbers and percentages of deaths of patients under anesthesia at the Alfred Hospital, Melbourne, during the period from January 1, 1932, to December 31, 1936 (see Tables I to V).

#### The Melbourne Dental Hospital.

MR. NOEL E. E. HEATH presented statistics showing the numbers of operations performed under various types of

anesthesia at the Melbourne Dental Hospital from January 1, 1932, to December 31, 1936. There were no deaths during anesthesia; but one patient died five months after a general anæsthetic from pulmonary abscess and a secondary cerebral abscess resulting from the inhalation of a tooth (see Tables VI and VII).

#### The Adelaide Hospital.

DR. GILBERT BROWN presented statistics of deaths of persons under anesthesia at the Adelaide Hospital during the period from January 1, 1932, to December 31, 1936 (see Tables VIII to XI).

#### The Royal Melbourne Hospital.

DR. J. COLEATCH presented statistics of anæsthetic fatalities at the Royal Melbourne Hospital during the period from July 1, 1932, to June 30, 1937 (see Tables XII and XIII).

#### The Women's Hospital, Melbourne.

DR. W. L. COQUHOUN presented statistics of the deaths of patients at the Women's Hospital, Melbourne, during the period January 1, 1932, to December 31, 1936 (see Tables XIV and XV).

#### The Queen Victoria Hospital, Melbourne.

DR. AGNES DONALDSON presented statistics showing the numbers of operations under anesthesia and anæsthetic fatalities at the Queen Victoria Hospital, Melbourne, during the period from January 1, 1932, to December 31, 1936 (see Table XVI).

#### Perth Hospital.

DR. GILBERT TROUP presented statistics of anæsthetic fatalities at the Perth Hospital during the period from January 1, 1933, to December 12, 1936 (see Tables XVII and XVIII).

#### Prince Henry's Hospital, Melbourne.

DR. MARJORIE HUGHES presented statistics of deaths of persons under anesthesia at Prince Henry's Hospital, Melbourne, during the period from January 1, 1932, to December 31, 1936 (see Tables XIX and XX).

#### The Adelaide Children's Hospital.

DR. E. COUPER BLACK presented statistics of fatalities associated with anesthesia at the Adelaide Children's Hospital during the period from October 1, 1931, to September 30, 1932 (see Tables XXI to XXIII).

#### The Royal Prince Alfred Hospital, Sydney.

DR. W. I. T. HOTTEN presented statistics of deaths of patients under anesthesia at the Royal Prince Alfred Hospital, Sydney, during the period from July 1, 1924, to June 30, 1931. The number of deaths recorded was 32 (see Table XXIV).

#### Saint Vincent's Hospital, Sydney.

DR. HUGH HUNTER presented statistics, collected by DR. H. J. DALY, of deaths of patients under anesthesia at Saint Vincent's Hospital, Sydney, from January 1, 1932, to December 31, 1936. During this period 12,327 anesthetics were administered to indoor patients and 6,913 to outdoor patients. Ten deaths were recorded (see Table XXV).

#### The Children's Hospital, Perth.

During the period from January 1, 1932, to December 31, 1936, four deaths of patients under anesthesia occurred at the Children's Hospital, Perth. No records of the numbers of anesthetics were presented (see Table XXVI).

#### The Children's Hospital, Melbourne.

DR. M. KENT HUGHES presented statistics showing the numbers of patients who had died under anesthesia at the Children's Hospital, Melbourne, during the period from 1932 to 1937 (see Tables XXVII and XXVIII).

#### Collected Statistics of Eight Hospitals.

DR. GEOFFREY KAYE presented statistics obtained from eight Melbourne hospitals, namely: the Alfred Hospital, the Royal Melbourne Hospital, the Women's Hospital, the Melbourne Dental Hospital, Saint Vincent's Hospital, Prince Henry's Hospital, the Queen Victoria Hospital, and the Children's Hospital (see Tables XXIX to XXXVII).

TABLE I.  
(The Alfred Hospital.)  
Details of 22 Fatalities during Anesthesia.

Number.	Operation.	Age.	Sex.	Anesthetic.	Clinical Condition.	Urine.	Heart.
1	Trephine for middle meningeal hemorrhage.	16	M.	Ether (open).	Coma; spastic limb.	No record.	No record.
2	Suture of lacerations of face and scalp.	7	M.	Ether (open).	Little shock. Recently convalescent from scarlatinal nephritis.	No record.	No abnormal signs.
3	Operation for perforated duodenal ulcer.	63	M.	Ether (open).	Ulcer perforated three hours before.	No record.	No abnormal signs.
4	Operation for mastoiditis with lateral sinus thrombosis.	7 Mths.	M.	Ether (open).	Desperately ill. Bronchopneumonic signs in lungs.	No record.	No abnormal signs.
5	Lobectomy for bronchogenic carcinoma of lung.	39	F.	Nitrous oxide.	A previous attempt at lobectomy had been defeated by hemorrhage.	No record.	Record incomplete, but apparently no gross lesion.
6	Cerebral exploration for internal hydrocephalus.	5	F.	Nitrous oxide.	High cerebral tension. Papilledema and chorioiditis. Had received a short ether anesthetic for ventriculography three days before.	No record.	No abnormal signs.
7	Thyroidectomy for exophthalmic goitre.	25	F.	Ethylene.	Very toxic.	Normal.	Pulmonary second sound accentuated; pulmonary systolic bruit.
8	Removal of radium implant for carcinoma of larynx.	62	M.	Ethylene.	Enfeebled. Râles audible in lungs. Had received a long endotracheal ether anesthetic one week previously.	Normal.	Extrastoles; mitral first sound duplicated.
9	Amputation of foot for diabetic gangrene.	56	F.	Ethylene.	Toxic.	Sugar, albumin, acetone.	No abnormal signs.
10	Operation for relief of incisional hernia.	72	F.	Ethylene.	Obstruction had existed for four days. Slight cyanosis.	?	No abnormal signs.
11	Operation for relief of volvulus of sigmoid colon.	47	F.	Ethylene.	Gravely ill. Lips cyanosed and pulse almost imperceptible.	?	No abnormal signs.
12	Choledochostomy for acute pancreatitis.	70	F.	Ethylene.	Gravely ill.	?	Right side of heart enlarged; generalized systolic bruit.

TABLE I.

(The Alfred Hospital.)

Details of 22 Fatalities during Anesthesia.

Pulse Rate.	Temperature.	Blood Pressure in Millimetres of Mercury.	Respiration Rate.	Time and Manner of Death.	Autopsy Findings.	Comment.
?	?	?	?	Died during closure of trephine wound, after very light ether analgesia.	No record.	Death probably due to cerebral trauma.
96	98.6° F.	114	24	Respiratory failure after operation had proceeded for 70 minutes.	Heart normal. Airways clear. Lungs congested and edematous. Other organs normal. Skull intact. Cerebral congestion with petechial hemorrhages.	Death possibly due to asphyxia, possibly to cerebral concussion.
68	97.4° F.	155/85	28	Vomited during induction; again vomited towards end of operation and became asphyxiated.	Heart dilated but normal. Aortic atheroma. Other organs normal. Lungs intensely congested and edematous, and bronchi full of vomitus.	Death by inhalation of vomitus.
144	102 F.	?	60	Circulatory failure after operation had proceeded for two hours.	Heart normal. Airways clear. Lungs congested and bronchopneumonic; right basal consolidation. Other organs normal. Mastoiditis and lateral sinus thrombosis.	Death from circulatory failure in a very toxic patient.
84	98.4° F.	?	20	Death from circulatory failure following intense hemorrhage from stump of bronchial artery.	Heart normal. A pint of free blood in thoracic cavity. Right lower lobe excised. Tumour found in stump of right bronchus. Areas of collapse in left lung. Other organs normal.	Death from haemorrhage.
72	98.2° F.	80	24	Death from sudden cardiac failure whilst <i>dura mater</i> was being opened.	Ependymitis around Sylvian aqueduct. Third ventricle dilated. Hydrocephalus. No tumour seen. Other organs normal.	Death from medullary central failure. A poor anaesthetic risk.
138	98.4° F.	170/100	?	Copious excretion of mucus, embarrassing respiration and producing fatal asphyxia during operation.	Thymus large. Heart in fair order. Lungs congested and edematous. Airways full of thick mucus. All other organs congested.	Death due to asphyxia by mucus, possibly preventable by intubation and aspiration of bronchial tree.
120	100.2° F.	140	20	Primary respiratory failure during induction. Cardiac failure followed so rapidly that endotracheal insufflation of oxygen was unavailing.	Heart fibrous, dilated. Aorta atherosomatous. Emphysema, with patchy pulmonary collapse. Carcinoma of pyriform fossa; laryngeal oedema.	Death by asphyxia, the risk of which was enhanced by laryngeal oedema.
112	101.4° F.	170/100	26	Succumbed at end of operation.	Coronary sclerosis; bilateral hydrothorax; basal collapse of lungs. Pancreas fatty, degenerated. Kidneys large, sub-granular. Old hydatid of liver.	A very poor anaesthetic risk.
80	99.4° F.	130/90	24	Died during operation.	No record available.	Clinically a grave anaesthetic risk.
150	98.6° F.	?	40	Died during induction.	Heart normal. Aortic and coronary atherosoma. Lungs congested. Liver swollen, friable. Large gut hugely dilated. Sigmoid volvulus. Pachymeningitis; some internal hydrocephalus.	A bad anaesthetic risk.
96	96.4° F.	122/90	24	Died during closure of peritoneal wound.	Heart large, fibrous, dilated. Valves calcareous. Coronary arteries almost occluded. Gross aortic atherosoma. Pleural adhesions. Lungs edematous. Liver fibrous. Acute pancreatitis.	A grave anaesthetic risk.

TABLE I.—Continued.

(The Alfred Hospital.)

Details of 22 Fatalities during Anesthesia.

Number.	Operation.	Age.	Sex.	Anesthetic.	Clinical Condition.	Urine.	Heart.
13	Laparotomy for possible fat necrosis following cholecystectomy.	52	F.	Ethylene.	Diabetic. Cholecystectomy on previous day under local anesthesia.	Sugar present.	Right side of heart enlarged; signs else normal.
14	Resection of bowel for carcinoma of sigmoid.	76	M.	Spinal (drug and technique not recorded).	Very debilitated.	?	No abnormal signs.
15	Operation for acute appendicitis, general peritonitis.	64	M.	Spinal (2.0 cubic centimetres of 0.5% "Percain" solution, preceded by ephedrine).	Gravely ill. Congestion of bases of lungs.	?	Sounds feeble.
16	Resection of bowel for carcinoma of sigmoid.	66	F.	Spinal (1.75 cubic centimetres of 0.5% "Percain" solution).	Relatively healthy, in view of age and local lesion. Previous colostomy had been performed under ether anesthesia.	?	No abnormal signs.
17	Attempted extirpation of cerebellar tumour.	11	M.	Local infiltration ("Ethocaine"), preceded by sedation with "Avertin" (dose not recorded).	Apparently well, except for signs of local neurological lesion.	Normal.	No abnormal signs.
18	Extirpation of cerebellar tumour.	4	F.	Local infiltration ("Ethocaine"); ether analgesia at intervals.	Head enlarged. Gross signs of local neurological lesion.	Trace of sugar; otherwise normal.	No abnormal signs.
19	Cerebral decompression and opening of cerebral tumour (cyst).	42	M.	Local infiltration ("Ethocaine").	Moribund. Collapse after ventriculography four hours before, so was returned to theatre and decompression performed.	Normal.	No abnormal signs.
20	Ventriculography for hydrocephalus.	3 Mths.	M.	Local infiltration ("Ethocaine").	No record.	No record.	No record.
21	Tonsillectomy.	23	M.	Local application of 10% cocaine solution; local injection of 25 cubic centimetres of 1% "Ethocaine" solution.	Robust young man. Antrostomy performed a week previously under ether anesthesia.	Normal.	No abnormal signs.
22	Radical drainage of frontal sinus for sinusitis.	25	M.	Ether (endotracheal).	Healthy apart from local lesion.	Normal.	No abnormal signs.

TABLE I.—Continued.

(The Alfred Hospital.)

Details of 22 Fatalities during Anesthesia.

Pulse Rate.	Temperature.	Blood Pressure in Millimetres of Mercury.	Respiration Rate.	Time and Manner of Death.	Autopsy Findings.	Comment.
80	98.0° F.	?	24	Died whilst on the way back to bed after the operation.	Occlusion of branch of left pulmonary artery, with infarction. No evidence of pancreatitis.	Abdominal symptoms apparently due to pulmonary embolism. Very grave anesthetic risk.
100	97.0° F.	210/130	20	Death from circulatory failure during exploration of abdomen.	Heart normal. Lungs congested. Cancerous ring stricture of sigmoid. Secondary deposits in liver. Slight renal degeneration.	Spinal anesthesia questionable in view of debility and high blood pressure.
108	101.2° F.	?	36	Death from synchronous circulatory and respiratory failure about ten minutes after injection and before operation had begun.	Heart enlarged and fibrous. Coronary atherosclerosis and sclerosis. Aortic valve calcified, mitral fibrous. Gross aortic atherosclerosis. Lungs congested, edematous. Toxic spoiling of kidneys. Gangrenous appendix; peritonitis.	A desperate anesthetic risk. Local anesthesia might well have been preferred to spinal.
84	98.2° F.	?	18	Death from circulatory failure after operation had proceeded for forty minutes.	Heart muscle soft and pale. Slight aortic atherosclerosis. Lungs congested; bases edematous. Liver and kidneys soft and pale. Other organs congested. Extensive rectal tumour involving bladder and uterus.	Death from circulatory failure.
96	98.0° F.	?	24	Circulatory depression was soon evident at operation, and decompression only was attempted. Death occurred an hour after the termination of the operation.	Extensive cerebellar tumour, with internal hydrocephalus. Cerebral ventricles greatly distended. Pressure on medulla, producing "medullary cone".	Death probably due to the local lesion rather than to the anesthetic.
116	98.4° F.	?	?	Circulatory failure when operation had lasted for 90 minutes; revived by blood transfusion. Again circulatory failure during closure of skull wound two hours later. No ether was used for nearly an hour before death.	Heart, lungs and kidneys normal. Large cystic glioma of <i>vermis cerebelli</i> , extending upwards towards cerebrum and downwards over medulla. Medulla flattened. Internal hydrocephalus.	Death from circulatory failure during cerebellar operation. The ether probably played but a small part in the circulatory depression.
88	97.6° F.	?	?	Respiration failed soon after the ventriculography and was maintained endotracheally for nine hours, that is during the second operation and for four hours after. The circulation gradually failed.	No record available.	Death from cerebral central failure, probably unrelated to the anesthetic.
?	?	?	?	Sudden circulatory collapse and death during the performance of ventriculography.	No record available.	Death from cerebral central failure, probably unrelated to the anesthetic.
?	?	?	?	Coma, cyanosis and violent convulsions immediately following anesthesia. Oxygenation was maintained endotracheally, but convulsions continued for 2½ hours, not being abolished by ether. Death occurred from gradual circulatory failure. Temperature 106° F.	Heart muscle red and firm; cavities dilated; valves normal. Lungs congested and edematous; some mucus in air passages. Other organs normal but congested. No organic lesion found to account for death.	Death from intoxication by cocaine (or, less probably, by "Ethocaine").
?	?	?	?	Uneventful operation lasting 75 minutes. Endotracheal tube withdrawn when cough reflex had returned. House surgeon was summoned an hour later to find patient dead in bed.	Heart relaxed and dilated, but otherwise normal. Lungs distended; air passages full of blood and mucus. Brain congested. Other organs normal.	Death by suffocation by inhaled blood and mucus.

TABLE II.

(The Alfred Hospital.)

*Analysis of 17,701 Operations upon In-patients, according to Anesthetics Employed and the Anesthetic Risk, assessed according to the Standards of the International Anesthesia Research Society.<sup>1</sup>*

Anesthetic.	Number of Cases.	Risk.				
		A.	B.	C.	D.	Not Stated.
Ethyl chloride	11	6	1	—	—	4
Ether	9,388	2,623	4,276	450	50	1,889
Chloroform	75	11	21	9	3	31
Nitrous oxide	771	88	257	267	56	103
Ethylene	1,453	99	424	612	108	210
Gas, unspecified	111	1	23	13	2	72
Cyclopropane	—	—	—	—	—	—
Regional and local	3,014	44	153	31	24	2,871
Spinal	1,141	54	—	46	9	879
"Avertin", alone or with inhalational supplement	11	—	—	1	1	9
Intravenous barbiturates, alone or with inhalational supplement	7	—	2	1	—	4
Unspecified <sup>2</sup>	1,719	67	203	32	7	1,410
Total	17,701	2,993	5,404	1,462	260	7,582

<sup>1</sup> Defined by F. McMechan ["Transactions of the Third Session of the Australasian Medical Congress (British Medical Association)"].

<sup>2</sup> There was evidence that an anesthetic had been given and an operation performed, but no details were available.

TABLE III.

(Alfred Hospital.)

*Percentage of Deaths on the Operating Table in 17,701 Administrations of various Anesthetics to In-patients.*

Anesthetic.	Number of Cases.	Number of Deaths.	Percentage Mortality.
Ethyl chloride	11	—	—
Ether	9,388	5	0·05
Chloroform	75	—	—
Nitrous oxide	771	2	0·26
Ethylene	1,453	7	0·49
Gas, unspecified	111	—	—
Regional and local	3,014	4	0·13
Spinal	1,141	3	0·26
"Avertin"	11	1	(9·0)
Intravenous barbiturates	7	—	—
Anesthetic unspecified	1,719	—	—
Total	17,701	22	0·12

TABLE IV.

(The Alfred Hospital.)

*Details of 10,612 Anesthetics given in the Out-patient Department. (There was no fatality.)*

Operation.	Number of Cases.	General Anesthesia.	Local Anesthesia.
Minor general surgery	1,393	821	572
Ear, nose and throat	3,897	3,502	395
Dental	5,322	989	4,333
Total	10,612	5,312	5,300

TABLE V.

(The Alfred Hospital.)

*Fatalities in 10,119 Cases in which the Anesthetic Risk had been assessed by the Standards approved by the International Anesthesia Research Society.*

Anesthetic.	"A" Risk.		"B" Risk.		"C" Risk.		"D" Risk.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Ethyl chloride	11	—	1	—	—	—	—	—
Ether	2,623	1	4,276	—	450	1	50	1
Chloroform	6	—	21	—	9	—	3	—
Nitrous oxide	88	—	257	—	267	2	56	—
Ethylene	99	—	424	—	612	—	108	6
Gas, unspecified	1	—	23	—	13	—	2	—
Regional and local	44	—	44	—	31	—	24	1
Spinal	54	—	153	—	46	—	9	1
"Avertin"	—	—	—	—	1	—	1	—
Intravenous barbiturates	—	—	2	—	1	—	—	—
Unspecified	67	—	203	—	32	—	7	—
Total	2,993	1	5,404	—	1,462	3	260	9
Percentage mortality	0·03	—	—	—	0·20	—	3·46	—

TABLE VI.  
(The Melbourne Dental Hospital.)  
General Anesthetics Administered from 1932 to 1936, inclusive.

Year.	Number of Cases.	Number of Teeth Extracted.		Total.
		Deciduous.	Permanent.	
1932 ..	5,059	13,993	27,967	41,960
1933 ..	4,588	14,104	20,782	34,856
1934 ..	4,843	14,367	25,660	40,027
1935 ..	5,229	15,013	32,313	47,326
1936 ..	5,187	17,754	30,387	48,141
Total ..	25,506	74,931	137,079	212,010

TABLE VII.  
(The Melbourne Dental Hospital.)  
Operations under Local Analgesia during the Period 1932-1936.

Year.	Number of Cases.	Number of Teeth Extracted.		Total.
		Deciduous.	Permanent.	
1932 ..	7,697	1,069	18,468	19,537
1933 ..	6,929	822	17,972	18,794
1934 ..	6,183	796	14,044	14,840
1935 ..	6,449	1,205	14,306	15,511
1936 ..	6,710	955	15,177	16,132
Total ..	33,968	4,847	79,967	84,814

TABLE VIII.  
(The Adelaide Hospital.)  
Fatalities under the Different Anesthetics.

Anesthetic.	Anesthetic Risks.					Total.
	A.	B.	C.	D.	Unstated.	
Ethyl chloride ..	..	1	6	5	1	20
Ether ..	2	6	6	5	1	20
Chloroform ..	1	1	7	1	1	9
Nitrous oxide ..	1	1	7	1	1	9
Ethylene ..	1	1	7	1	1	9
"Gas" (kind unstated)	..	..	..	..	..	..
Local ..	..	..	..	..	..	..
Spinal ..	..	..	..	..	..	..
"Avertin"—	..	..	..	..	..	..
Alone ..	..	..	..	..	..	..
With inhalation supplement ..	..	..	2	..	..	2
Barbiturates (intravenously) ..	..	..	..	..	..	..
Anesthetic unstated ..	..	..	..	..	1	1
Total ..	2	9	18	20	2	51

TABLE IX.  
(The Adelaide Hospital.)  
Number of Anesthetics given in the Dental Department (1932-1936).

Ethyl chloride ..	..	..	..	..	..	135
"Somnoform" ..	..	..	..	..	..	17
Ether ..	..	..	..	..	..	4
Nitrous oxide ..	..	..	..	..	..	1,112
Ethylene ..	..	..	..	..	..	8,781
Intravenous "Evipan Sodium" ..	..	..	..	..	..	111
Intravenous "Pentothal Sodium" ..	..	..	..	..	..	13
Local ..	..	..	..	..	..	22,676
Total ..	..	..	..	..	..	27,849

NOTE.—Figures for minor operations on out-patients for the whole five-year period are not available. No fatality occurred in the dental department.

TABLE X.  
(The Adelaide Hospital.)  
Types of Anesthetic Used during the Six Months from July 1, 1936, to December 31, 1936.

Operating Theatre.	Inhalation.					Total.
	Ether.	Chloroform.	Ethyl Chloride.	Nitrous Oxide.	"Pen-totahal Sodium."	
Number I ..	960	4	176	135	1	117
Number II ..	328	1	1	1	1	36
Gynaecological ..	366	3	26	9	—	—
Da Costa ..	300	5	—	—	—	—
Ophthalmic ..	14	—	1	—	27	64
Casualty ..	13	1	52	—	—	—
Out-Patient ..	11	1	401	105	1,320	1,567
Dental ..	—	—	10	3	5	40
Total ..	1,882	4	16	360	17	117
					64	36
					40	48
					117	48
					1,567	1,882

TABLE XI.  
(The Adelaide Hospital.)  
*Analysis of Anesthetic Fatalities (1932-1936.)*

Number.	Sex.	Age.	Diagnosis.	Attempted Operation.	Anesthetic.	Clinical Condition.	Heart.	Lungs.	Urine.
1	M.	41	Gas gangrene of arm.	Amputation of arm.	Ethylene.	Severely toxicemic.	Nil abnormal.	Nil abnormal.	Nil abnormal.
2	M.	50	Post-operative "burst abdomen" and intestinal obstruction.	Enterostomy.	Nitrous oxide.	Poor; much shock.	Nil abnormal.	Nil abnormal.	Nil abnormal.
3	M.	67	Intestinal obstruction.	Laparotomy.	Ethylene.	Very poor. Vomiting quantities of yellow fluid.	Nil abnormal.	Nil abnormal.	Bile.
4	F.	48	Cholecystitis.	Cholecystectomy.	Ether.	Good.	Apex-beat five inches from mid-line.	No record.	Bile.
5	F.	53	Fluid in abdomen after cholecystectomy.	Laparotomy.	Ether.	Poor vomiting.	Nil abnormal.	Nil abnormal.	Nil abnormal.
6	M.	42	Tetanus.	Treatment of tetanus.	"Avertin."	Very poor. Had been under treatment for three days.	Nil abnormal.	Nil abnormal.	Nil abnormal.
7	F.	27	Exophthalmic goitre.	Subtotal thyroidectomy.	"Avertin." Nose sprayed with cocaine solution. Endotracheal ethylene.	Fair.	Nil abnormal Previous effort-syndrome.	Nil abnormal	Nil abnormal.
8	M.	79	Diabetic gangrene of leg.	Amputation.	Gas anaesthetic, kind unstated.	Very poor.	Enlarged. Aortic murmur.	Nil abnormal.	Much sugar and albumin present.
9	F.	27	Cerebellar tumour.	Exploration.	Ether (endopharyngeal).	Intermittent fever. Leucocytosis of 14,000.	Nil abnormal.	Nil abnormal.	Nil abnormal.
10	M.	72	Perforated gastric ulcer.	Suture of perforation.	Not stated.	—	—	—	—
11	M.	66	Cut throat.	Arrest of haemorrhage.	Ether.	Anæmic from haemorrhage. Diabetic bronchitis.	Sounds inaudible.	Rhonchi and rales all over chest.	None obtainable.
12	F.	26	Salpingitis and retroversion.	Salpingectomy.	Ether.	Good.	Nil abnormal.	Nil abnormal.	—
13	M.	68	Acute pancreatitis.	Laparotomy.	Ether.	Poor. Weak pulse; shock.	Nil abnormal.	Nil abnormal.	Nil abnormal.

TABLE XI.

(The Adelaide Hospital.)

*Analysis of Anesthetic Fatalities (1932-1936).*

Pulse Rate.	Temperature.	Blood Pressure in Millimetres of Mercury.	Respiration Rate.	Stage at which Death Occurred.	Manner of Death.	Autopsy Findings.	Anesthetic Risk.	Preventability.	Comment.
104	° F. 97.0	?	24	Forty minutes after operation.	?	—	D	Probably unavoidable.	Very toxicemic and shocked. Anesthetic had no influence on death.
120	96.6	—	24	During operation.	Respiratory.	—	C	Probably unavoidable.	Suffering from grave shock and intestinal obstruction.
68	96.0	—	20	During operation.	Respiratory.	—	D	Possibly preventable.	Local, or endotracheal anesthesia might have prevented inhalation of vomitus.
86	98.6	146/90	20	Twelve hours after operation	Circulatory.	—	B	Possibly preventable.	Respiratory failure under anesthetic. Cardiac massage for thirty minutes. Returned to ward in semi-moribund condition.
130	100.4	—	26	During operation.	Respiratory.	Marked distension of intestines.	D	Possibly unavoidable.	Gaseous anesthetic would have been preferable.
130	98.4	132/82	24	One hour after "Avertin" had been given.	?	—	D	Probably unavoidable.	Three administrations of "Avertin" during previous two days. Choice of anesthetic reasonable.
88	97.2	146/98	20	Before operation.	Combined circulatory and respiratory.	—	C	Frankly preventable.	Death from acute cocaine poisoning. Patient, being unconscious, could not spit out excess. Possible idiosyncrasy.
96	100.0	—	22	During operation.	?	—	D	Probably unavoidable.	Cardio - renal disease. Fasting blood sugar value, 0.303%.
100	97.8	120/80	20	At end of operation.	—	Small ependymal cyst of right ventricle blocking the foramen of Munro.	B	Possibly preventable.	Endotracheal anesthesia would have been better.
—	—	—	—	During operation.	—	—	—	—	No further notes obtainable.
124	95.0	—	—	During operation.	Respiratory.	—	D	Probably unavoidable.	Suffering from shock, diabetes, and bronchitis, which should contraindicate ether anesthesia.
96	98.0	—	20	Before operation.	Circulatory.	Congestion of brain, liver, kidneys and spleen.	A	Possibly preventable.	No definite pathological condition found to account for death.
100	97.0	—	24	Fifteen minutes after operation.	Circulatory.	Turbid fluid in peritoneal cavity. Fat necrosis; incipient gangrene of transverse colon.	C	Probably unavoidable.	—

TABLE XI.—Continued.  
(The Adelaide Hospital.)  
Analysis of Anesthetic Fatalities (1933-1936).

Number.	Sex.	Age.	Diagnosis.	Attempted Operation.	Anesthetic.	Clinical Condition.	Heart.	Lungs.	Urine.
14	M.	67	Carcinoma of oesophagus.	Oesophagoscopy.	Ether.	Poor; had lost three stone in weight.	Nil abnormal.	Nil abnormal.	Nil abnormal.
15	M.	54	Volvulus of small intestine.	Untwisting of volvulus and enterostomy.	Ether.	Fair.	Nil abnormal.	Nil abnormal.	Nil abnormal.
16	M.	68	General peritonitis.	Laparotomy and drainage.	Ether.	Had vomited continuously for 24 hours. Colectomy for carcinoma five years previously.	Sounds faint.	Nil abnormal.	—
17	M.	76	Sinus after perineal prostatectomy.	Secondary suture.	Nitrous oxide.	Poor.	Nil abnormal.	A few crepitations at bases.	—
18	M.	47	Osteomyelitis of jaw.	Incision of cheek.	Ether.	Very toxemic.	Nil abnormal.	Nil abnormal.	—
19	M.	71	Epithelioma of tonsil.	Diathermy.	Chloroform (endotracheally).	Fair.	Nil abnormal.	Nil abnormal.	Nil abnormal.
20	M.	47	Hemorrhage after operation for stricture of ureter.	Reopening wound.	Ethylene.	Severely shocked. Required blood transfusion just before operation.	Nil abnormal.	Nil abnormal.	Urea 1%. Occasional red blood cell seen.
21	F.	44	Carcinoma of gall-bladder.	Cholecysto-gastrectomy.	Ether.	(?) Angina pectoris.	Aortic second sound accentuated.	Nil abnormal.	Nil abnormal.
22	M.	79	Fractured skull.	Craniotomy.	Ether (endopharyngeally).	Unconscious; shocked.	Nil abnormal.	Nil abnormal.	Trace of sugar.
23	M.	56	Avulsion of upper limb.	Amputation.	Ethylene.	Very poor. Much shock, even after blood transfusion.	Nil abnormal.	Moist sounds at both bases.	—
24	F.	45	Cerebellar tumour.	Removal of tumour.	Local and ether.	Good.	Nil abnormal.	Nil abnormal.	Nil abnormal.
25	M.	56	Malignant glands of neck.	Block dissection.	Ether.	Good.	Nil abnormal.	Nil abnormal.	Nil abnormal.

TABLE XI.—Continued.

(The Adelaide Hospital.)

*Analysis of Anesthetic Fatalities (1932-1936).*

Pulse Rate.	Temperature.	Blood Pressure in Millimetres of Mercury.	Respiration Rate.	Stage at which Death Occurred.	Manner of Death.	Autopsy Findings.	Anesthetic Risk.	Preventibility.	Comment.
80	98·4	—	20	Before operation.	Circulatory.	Carcinoma of oesophagus, with ulceration in left bronchus; pulmonary consolidation. Nephritis. Enlarged liver and spleen. Diverticulitis. Atheroma of aorta.	D	Probably unavoidable.	A better preoperative examination would have precluded any operation.
96	96·4	—	20	Twenty minutes after operation.	Respiratory.	—	B	Possibly preventible.	Vomited during operation. Probably asphyxia from inhaled vomitus. Endotracheal anesthesia might have prevented this.
124	97·2	—	24	After operation.	Circulatory.	—	D	Probably unavoidable.	Suffering from shock and toxæmia. Gas anesthetic would have been safer.
112	98·6	—	22	During operation.	?	Carcinoma of prostate; pyonephrosis; pyelitis; atheroma of aorta.	C	Possibly unavoidable.	Anesthetic seems reasonable.
116	104·4	—	34	Before operation.	Circulatory.	Fatty heart. Dilated fibrotic liver. Enlarged spleen.	C	Possibly unavoidable.	Gas anesthesia would have been safer.
76	97·0	—	20	During operation.	Circulatory.	—	B	Frankly preventible.	Liquid chloroform blown into lungs owing to wrong connexion of Junker's bottle. A safety bottle should have been used, or preferably endotracheal nitrous oxide.
148	99·4	—	24	On return to the ward.	Circulatory.	—	D	Probably unavoidable.	Anesthetic does not appear to have been a factor in causing death.
96	97·0	140/80	24	Immediately on reaching the ward.	?	—	B	Notes too scanty to determine.	Choice of anesthetic appears reasonable.
120	97·0	—	18	During operation.	Circulatory.	Fractured skull; diffuse subdural hemorrhage; laceration of brain.	D	Probably unavoidable.	Uncontrollable hemorrhage during operation. Death not due to anesthetic.
80	98·4	—	18	During operation.	Circulatory.	—	D	Probably unavoidable.	Practically moribund. Anesthetic reasonable.
88	98·0	—	20	During operation.	Circulatory.	—	C	Probably unavoidable.	Uncontrollable hemorrhage. Anesthetic not responsible for death.
112	97·0	—	24	During operation after one hour.	Respiratory.	—	B	Probably preventible.	Anoxæmia during operation. Endotracheal anesthesia would have prevented this.

TABLE XL—Continued  
(The Adelaide Hospital.)  
Analysis of Anesthetic Fatalities (1932-1936).

Number.	Sex.	Age.	Diagnosis.	Attempted Operation.	Anesthetic.	Clinical Condition.	Heart.	Lungs.	Urine.
26	F.	12	Tetanus.	Incision of foot.	Chloroform.	Poor. Incubation period of six days. Spasms every three minutes.	Systolic murmur at apex.	Nil abnormal.	—
27	F.	29	Ruptured ectopic gestation.	Salpingectomy.	No record.	Blanched from hemorrhage. Air hunger. Restlessness. Hematemesis. Melena.	Nil abnormal.	Nil abnormal.	—
28	M.	26	Cerebellar tumour.	Removal of tumour.	Local, "Avertin", ether.	Fair.	Nil abnormal.	Nil abnormal.	Nil abnormal.
29	M.	67	Intestinal obstruction.	Laparotomy.	Local ("Novocain").	Very poor. Fecal vomiting.	Nil abnormal.	Nil abnormal.	Nil abnormal.
30	M.	52	Suppuration of knee joint.	Drainage.	"Evipan Sodium."	Very poor. Semi-coma. Pyrexia.	Nil abnormal.	Nil abnormal.	—
31	M.	—	Streptococcal meningitis.	Lumbar puncture.	"Evipan Sodium."	Very poor.	Nil abnormal.	Nil abnormal.	Nil abnormal.
32	M.	74	Post-operative ileus.	Treatment.	Spinal (10 cubic centimetres of "Percain" solution).	Poor. Abdominal distension.	Enlarged. Extrasystoles.	Nil abnormal.	Nil abnormal.
33	M.	39	Cerebral tumour.	Removal of tumour.	Local and nitrous oxide (endotracheally).	Good.	Nil abnormal.	Nil abnormal.	—
34	F.	34	Lung abscess.	Drainage by cautery.	Nitrous oxide.	Poor. Prolonged sepsis, myocardial weakness.	Sounds faint.	Lung abscess of eight weeks' duration.	Nil abnormal.
35	F.	35	Malignant hypertension.	Division of anterior spinal nerve roots.	Ether (endotracheal).	Poor; previous hemiplegia.	Enlarged. Second aortic sound loud and ringing.	Nil abnormal.	Nil abnormal.
36	F.	54	Exophthalmic goitre.	Subtotal thyroidectomy.	Nitrous oxide.	Poor.	Enlarged.	A few rhonchi. X rays showed possible chronic tuberculosis.	Nil abnormal.
37	F.	37	Exophthalmic goitre.	Subtotal thyroidectomy.	Nitrous oxide.	Fair.	Enlarged. Pulmonary second sound accentuated.	Percussion note impaired over manubrium.	Nil abnormal.

TABLE XI.—Continued.  
(The Adelaide Hospital.)  
Analysis of Anesthetic Fatalities (1932-1936).

Pulse Rate.	Temperature.	Blood Pressure in Millimetres of Mercury.	Respiration Rate.	Stage at which Death Occurred.	Manner of Death.	Autopsy Findings.	Anesthetic Risk.	Preventability.	Comment
96	° F.—	—	—	Before operation.	?	T h y m u s 6.4 grammes (normal 25-36). Increase in size of lymphatic glands.	C	Possibly unavoidable.	Mask covering too thick. Choice of anesthetic reasonable.
160 (?)	95.4	—	28	At completion of operation.	Circulatory.	—	D	Probably unavoidable.	Practically moribund.
—	—	—	—	During operation, after three and a half hours.	Circulatory.	—	C.	Probably unavoidable.	Death from uncontrollable haemorrhage. Anesthetic had no influence.
120	97.0	—	24	During operation.	?	—	D	Probably unavoidable.	Intestinal obstruction relieved by operation for strangulated hernia on previous day. Death from shock. Anesthetic had no influence.
126	101.4	—	—	Eight hours after operation.	Respiratory.	—	D	Probably unavoidable.	Never recovered consciousness. Practically moribund. Gas anesthesia would have been preferable.
—	—	—	—	Before operation.	Circulatory.	—	D	Possibly unavoidable.	Probably unwise to give any anesthetic, as he was moribund.
88	98.0	—	20	Ten minutes after injection.	Circulatory.	—	D	Possibly unavoidable.	Spinal injection given in bed; this was inadvertent.
86	98.2	140/75	20	During operation, after one and a half hours.	Circulatory.	—	C	Probably unavoidable.	Excessive haemorrhage from very vascular tumour. Intravenous infusion of gum saline solution given during operation. Anesthetic had no influence.
110	103.2	—	24	During operation.	Respiratory.	—	C	Possibly preventable.	Anoxemia and straining during operation. Heavier premedication and more oxygen might have prevented this.
120	—	280/170	20	One and a half hours after operation.	Circulatory.	—	C	Possibly preventable.	Died from shock and haemorrhage. This might have been prevented if the operation had been done in two stages, or blood transfusion had been given during the operation.
120	—	140/80	—	During operation.	Respiratory.	—	C	Possibly preventable.	Respiration was obstructed during the operation. A change to endotracheal anesthesia might have averted this death.
—	—	—	—	During operation.	Circulatory.	—	C	Possibly preventable.	Cause of death presumed to be ventricular fibrillation, the onset of which would have been indicated by a blood-pressure chart. Choice of anesthetic reasonable.

TABLE XI.—Continued.

(The Adelaide Hospital.)

Analysis of Anesthetic Fatalities (1932-1936).

Number.	Sex.	Age.	Diagnosis.	Attempted Operation.	Anesthetic.	Clinical Condition.	Heart.	Lungs.	Urine.
38	M.	63	"Burst abdomen" after laparotomy.	Suture.	Ether.	Poor.	Nil abnormal.	A few rales.	Nil abnormal.
39	M.	67	Gas gangrene of amputation stump.	Opening wound.	Nitrous oxide.	Toxæmic and weak. Severe diabetes.	Nil abnormal.	Nil abnormal.	Sugar and acetone in large amounts.
40	M.	65	Osteomyelitis of frontal bone.	Drainage.	Ether (endotracheal).	Poor. Toxæmia and shock.	Nil abnormal.	Nil abnormal.	Nil abnormal.
41	M.	49	Suppurative hydatid of liver.	Drainage.	Ether.	Poor.	Nil abnormal.	Nil abnormal.	Nil abnormal.
42	M.	21	Ruptured liver.	Laparotomy.	Local and ethylene with ether.	Very poor. Shock from haemorrhage and compound fracture of leg.	Nil abnormal.	Nil abnormal.	Nil abnormal.
43	F.	65	Carcinoma of pylorus.	Laparotomy.	Local and ethylene.	Emaciated, dehydrated, anaemic.	Enlarged. Systolic murmur.	Nil abnormal.	Nil abnormal.
44	M.	76	Strangulated hernia.	Herniotomy.	Nitrous oxide.	Poor. Vomiting for two days.	Nil abnormal.	Nil abnormal.	Nil abnormal.
45	F.	33	Post-operative intestinal obstruction.	Laparotomy.	Spinal.	Very poor.	—	—	Nil abnormal.
46	F.	14	Septic tonsils.	Tonsillectomy.	Ether (endotracheal).	Good.	Nil abnormal.	Nil abnormal.	Nil abnormal.
47	M.	57	Peritonitis.	Laparotomy.	Ether followed by ethylene.	Very poor.	Nil abnormal.	Nil abnormal.	Nil abnormal.
48	M.	25	Alveolar abscess.	Drainage.	Ethyl chloride.	Fair.	Nil abnormal.	Nil abnormal.	Nil abnormal.
49	M.	78	Retention of urine.	Suprapubic cystotomy.	Ethylene.	Very poor. Uræmia, cardiac degeneration, asthma.	—	Asthma; rhonchi all over chest.	Nil abnormal.
50	M.	66	Malignant disease of lower jaw.	Partial excision of jaw.	Ether (endopharyngeal).	Poor.	—	—	—
51	M.	22	Bronchiectasis.	Lobectomy.	Nitrous oxide.	Fair.	Nil abnormal.	Bronchiectasis.	Nil abnormal.

TABLE XI.—Continued.  
(The Adelaide Hospital.)  
*Analysis of Anesthetic Fatalities (1932-1936).*

Pulse Rate.	Temperature.	Blood Pressure in Millimetres of Mercury.	Respiration Rate.	Stage at which Death Occurred.	Manner of Death.	Autopsy Findings.	Anesthetic Risk.	Preventability.	Comment.
—	° F.	—	—	One and a half hours after operation.	Circulatory.	—	C	Possibly preventable.	Anesthesia too light. Much straining, which increased shock.
124	101·8	—	32	During operation.	Circulatory.	—	D	Probably unavoidable.	Patient moribund.
120	103·0	—	—	During operation, after one hour.	Circulatory.	—	C	Possibly unavoidable.	Choice of anesthetic reasonable.
—	101·0	—	—	During operation.	Respiratory.	—	B	?	Cause of death unknown.
88	Did not register.	—	20	Half an hour after operation.	Circulatory.	—	D	Probably unavoidable.	Moribund from hemorrhage and shock.
—	—	—	—	During operation.	Respiratory.	—	C	Possibly preventable.	Premedication excessive. Dehydration should have been treated before operation.
120	96·4	—	36	Twenty minutes after operation.	Circulatory.	—	C	Possibly preventable.	Vomited fecal matter under anesthetic. Local anesthesia would have been safer.
160	100·0	90/50	32	During operation.	Respiratory.	—	D	Possibly unavoidable.	Anemia from operation for ectopic four days previously. Spinal anesthesia contraindicated with this low blood pressure.
88	98·0	—	20	One hour after operation.	Respiratory.	—	A	Frankly preventable.	Inhalation of vomitus during recovery. Inadequate post-operative attention.
104	100·0	—	28	At end of operation.	Respiratory.	—	D	Probably unavoidable.	Peritonitis and toxæmia. Local anesthesia would have been safer.
90	100·0	—	20	Before operation.	Respiratory.	No other abnormalities.	B	Possibly unavoidable.	Anesthetic convulsions, which came on under the ethyl chloride before ether was given.
90	97·4	—	20	During operation.	Respiratory.	—	D	Possibly unavoidable.	Choice of anesthetic reasonable. Local could not be used because of restlessness.
—	—	—	—	On return to ward.	?	—	?	—	No notes at all are available.
100	98·4	108/50	20	During operation.	Respiratory.	—	B	Probably preventable.	Asphyxia from secretions. Endotracheal anesthesia and suction might have prevented this.

TABLE XII.  
(The Royal Melbourne Hospital.)

Number.	Diagnosis and Attempted Operation.	Sex.	Age.	Premedication.	Anesthetic Agent.	Clinical Condition.	Urine.
1	Exophthalmic goitre. Hemithyroidectomy.	22	F.	Morphine (1/6 grain).	Nitrous oxide.	Had hemithyroidectomy a few weeks before; still very sick.	Normal.
2	Dislocated shoulder. Reduction. (Out-patient.)	?	M.	? Nil.	Nitrous oxide.	Acute alcoholism, chronic bronchitis and senility.	No record.
3	Caecal tuberculoma with obstruction : Bowel anastomosis.	50	F.	Morphine (1/6 grain); atropine (1/100 grain).	Ether (open, with carbon dioxide during induction).	Very sick and vomiting. Pulse poor.	Normal.
4	Carcinoma of larynx with oedema of glottis : Tracheotomy.	76	M.	Morphine (1/6 grain).	Local infiltration with "Novocain".	Emaciated. Fairly acute laryngeal obstruction; emergency tracheotomy.	No record.
5	Compound fracture of femur with gas gangrene : Amputation.	54	M.	—	Spinal (4.0 cubic centimetres of 0.4% solution of "Ethocaine") ephedrine.	Reduction et cetera under ether two days earlier; signs of bronchopneumonia.	Normal.
6	Cholecystitis, acute intestinal obstruction and peritonitis: Laparotomy.	79	M.	Morphine (1/6 grain); atropine (1/100 grain).	Ethylene and some ether.	Gravely ill, with slight cyanosis.	Normal.
7	Cerebral compression following head injury : Subtemporal decompression.	63	M.	—	Local infiltration with 0.5% "Novocain" solution.	Fractured skull four days previously; sudden onset of fits and coma.	Normal.
8	Bilateral tubo-ovarian abscess with peritonitis: Salpingo - oophorectomy and drainage.	37	F.	Morphine (1/6 grain); atropine (1/100 grain).	Ether (open; carbon dioxide during induction).	Gravely ill. Sudden rupture of abscess three hours previously.	Trace of albumin; casts.
9	Aneurysm at bifurcation of innominate artery : Ligature of both branches.	65	F.	Morphine (1/6 grain).	Nitrous oxide and some ether.	Apparently well except for hyperpnoea.	Normal.
10	Large umbilical hernia, with intestinal obstruction : Operation for relief.	59	F.	Atropine (1/150 grain).	Ether (open; carbon dioxide during induction).	Obese, with hyperpnoea. Toxic symptoms of moderate severity. Obstruction for several days.	Normal.
11	Boil : Incision. (Out-patient.)	20	F.	—	Chloroform.	Apparently well.	No record.
12	Pulmonary abscess : Drainage.	21	F.	Morphine (1/6 grain).	Nitrous oxide.	Patient weakened by long illness and several recent anaesthetics.	Normal.
13	Ruptured spleen : Splenectomy and auto-transfusion.	64	F.	—	Nitrous oxide and ether.	Patient suffering from shock; cyanosis and arteriosclerosis.	Normal.
14	Large retrosternal colloid goitre: Thyroidectomy.	24	F.	Chlorethane; atropine (1/100 grain).	Ether (intratracheal); carbon dioxide during induction.	Tracheal pressure, with occasional dyspnoea and cyanosis. Splenomegaly. 8.9% granulocytes.	Normal.

TABLE XII.  
The Royal Melbourne Hospital.)

Heart.	Pulse Rate.	Temper-ature.	Blood Pressure in Millimetres of Mercury.	Respira-tion Rate.	Time and Manner of Death.	Autopsy Findings.	Comment.
Apical systolic murmur.	116	° F. 98·4	126/74	28	Severe shock at conclusion of operation. Death one and a quarter hours later.	No record available.	Death probably wholly due to post-operative shock.
No record.	?	?	?	?	Death from circulatory and respiratory failure.	—	Poor anaesthetic risk; records too meagre for assessment of preventability.
Slightly dilated.	134	103·0	88/56	28	Death from respiratory failure one and a half hours after commencement.	No record available.	The patient was very sick.
No record.	?	?	?	?	Death from peripheral (suffocative) respiratory failure.	Moderate atheroma of heart and aorta. Epithelioma of pyriform fossa; oedema of glottis.	Asphyxia from laryngeal obstruction; anaesthetic not a factor.
No abnormal signs.	120	100·0	?	35	Death at conclusion of operation.	—	Poor anaesthetic risk. Nitrous oxide probably preferable to spinal.
No abnormal signs.	100	98·4	132/76	22	Increasing cyanosis throughout; simultaneous respiratory and circulatory failure after 25 minutes.	Heart dilated; lungs congested; early peritonitis; large gall-stone obstructing ascending colon.	Grave anaesthetic risk. Death due mainly to local lesion.
No abnormal signs.	60 (?)	99·4	130 (?)	?	Circulatory and respiratory failure after half an hour, before <i>dura mater</i> was opened.	—	Death probably due to cerebral contusion and oedema.
No abnormal signs.	104	102·0	80/65 (?)	28	Respiratory collapse at conclusion of operation (35 minutes).	No record available.	Grave anaesthetic risk. Probably local analgesia and nitrous oxide would have been better.
No abnormal signs.	100	98·4	200/100	24	Sudden cardio-respiratory failure after 45 minutes, during dissection of sub-clavian artery.	—	Severe surgical trauma, to which death was probably largely due.
No abnormal signs.	88	97·4	195/120	18	Died five minutes after commencement of induction.	Hypertrophy and dilatation of heart; coronary stenosis; congestion of lungs. Large umbilical hernia containing obstructed colon. Cerebral atheroma.	Death apparently from respiratory and circulatory failure. Poor risk.
No record.	?	?	?	?	Died of syncope five minutes after commencement of induction.	—	Record gives no explanation of what appears to have been an injudicious choice of anaesthetic.
No abnormal signs.	130	98·4	?	32	Died at conclusion of operation (duration not recorded).	Slight aortic atheroma. Multiple abscess cavities in left lung; emphysema of right lung.	Death from toxæmia and operative shock; anaesthetic not a factor.
Extrasystoles; systolic and diastolic murmurs.	118	96·8	92/50	28	Died just before conclusion of operation. Given blood transfusion and saline solution intravenously.	—	Very grave anaesthetic risk.
Heart displaced laterally; harsh systolic murmur.	120	97·2 (100·6 on previous night.)	122/84	20	Cyanosis early. Died after three hours from shock.	—	Death due to combined operative and anaesthetic shock; nitrous oxide would have been preferable to ether.

TABLE XII.—Continued.  
(The Royal Melbourne Hospital.)

Number.	Diagnosis and Attempted Operation.	Sex.	Age.	Premedication.	Anesthetic Agent.	Clinical Condition.	Urine.
15	General peritonitis with bleus : Operation for relief.	72	M.	Morphine (1/6 grain).	Local infiltration and nitrous oxide.	Desperately ill ; vomiting faecal material. Stomach washout before operation.	No record.
16	General peritonitis : Operation for relief.	50	M.	Chloretone (15 grains) ; atropine (1/120 grain).	Nitrous oxide.	Frequent vomiting. Moderate toxæmia.	Normal.
17	Carcinoma of kidney with secondaries in liver : Laparotomy.	46	M.	Morphine (1/6 grain) ; hyoscine (1/150 grain).	Local infiltration with 1% "Ethocaine" solution.	Patient desperately ill. Condition undiagnosed before death.	Normal.
18	Intestinal obstruction : Division of peritoneal bands, and ileostomy.	21	F.	—	Ether (open) ; 2·5 ounces only.	Appendicectomy three days previously. Free vomiting. Patient very sick.	Normal.
19	Chronic gastric ulcer with infiltration : Partial gastrectomy.	47	M.	Paraaldehyde (six drachms per rectum) ; chloretone (15 grains).	Local infiltration with four ounces of 1% "Novocain" solution plus a few cubic centimetres of 0·5% "Praxine" Ethyl chloride (2·0 cubic centimetres) and open ether (3·0 ounces).	Some rhonchi in chest ; mild wasting.	Slight trace of sugar ; trace of diacetic acid.
20	Compound fracture of humerus with gas gangrene : Exploration and cleansing of wound.	37	M.	—	Nitrous oxide.	Desperately ill ; having rigors. Open reduction under ether three days previously.	Normal.
21	Carcinoma of rectum with chronic obstruction : Laparotomy.	49	M.	Chloretone (15 grains) ; atropine (1/120 grain).	Ether (open) ; induction with ethyl chloride.	Enfeebled and moderately toxæmic.	Trace of albumin.
22	Compound fracture of femur and tibia with gas gangrene : Amputation.	20	M.	Morphine (1/6 grain).	Nitrous oxide.	Desperately ill despite transfusions. Had nitrous oxide anesthetic two days previously.	Trace of sugar.
23	Compound fracture of tibia and femur : Amputation.	45	M.	Morphine (1/6 grain).	Nitrous oxide.	Severe shock despite blood transfusion ; operation 18 hours after accident.	No record.
24	Anuria following auto-transfusion : Decapsulation of kidney.	34	F.	Morphine (1/6 grain).	Nitrous oxide.	Desperately ill ; cyanotic. Operation for ruptured ectopic five days previously.	Albumin in large quantity.
25	Cerebral tumour ; rapid onset of coma : Craniotomy and exploration.	55	F.	Morphine (1/6 grain) ; atropine (1/120 grain).	Ether (intratracheal) ; carbon dioxide during induction.	Comatose for few hours.	Trace of sugar and acetone.
26	Secondary ovarian hemorrhage : Laparotomy.	52	F.	Morphine (1/6 grain).	Nitrous oxide.	Exsanguinated. Ether anesthetic previous day for uterine and ovarian hemorrhage.	Trace of sugar.
27	Acute general peritonitis : Laparotomy and drainage.	14	F.	—	Spinal (4·0 cubic centimetres of 4% "Novocain" preceded by one grain of ephedrine).	Desperately ill and vomiting freely. Appendicectomy under ether five days previously.	No record.
28	Chronic tonsillitis with post-tonsillectomy hemorrhage : Operation for haemostasis.	36	M.	Morphine (1/6 grain) ; atropine (1/100 grain).	Ether (open).	Tonsillectomy ten hours previously ; hemorrhage persisted.	No record.

TABLE XII.—Continued.  
(The Royal Melbourne Hospital.)

Heart.	Pulse Rate.	Temper-ature.	Blood Pressure in Millimetres of Mercury.	Respira-tion Rate.	Time and Manner of Death.	Autopsy Findings.	Comment.
No abnormal signs.	118	° F. 101·0	75/50	44	Vomited during catheterization of ileum and died soon afterwards.	No record available.	Desperate anaesthetic risk.
Soft mitral systolic murmur.	?	100·2	100/75	?	Vomiting during induction; death before commencement of operation, possibly from respiratory failure.	Acute general peritonitis without evident cause; pleural adhesions; no sign of inhaled vomitus; heart normal.	Very poor anaesthetic risk.
No abnormal signs.	112	96·0	88/62	24	Died from respiratory failure following skin incision.	Coronary stenosis. Carcinoma of kidney, with secondaries in liver, other kidney and pleura.	Death from exhaustion; anaesthetic not a factor.
No abnormal signs.	140	97·0	?	24	Vomited during induction and at conclusion of operation; died from respiratory failure after one hour.	Heart normal; lungs congested; firm clot in pulmonary artery; paralytic ileus; terminal part of ileum gangrenous.	Death from toxæmia and respiratory failure; anaesthetic a very small factor.
No abnormal signs.	84	98·0	130/85	20	General anaesthesia necessary for restlessness; respiratory failure developed towards conclusion of operation after one and a quarter hours.	—	Death from combined operative and anaesthetic shock; nitrous oxide would have been a safer inhalational supplement.
No abnormal signs.	160	102·4	?	?	Condition rapidly deteriorated; death from respiratory failure towards conclusion of operation.	—	Death due to local lesion; anaesthetic not a factor.
No record.	100	?	170/90	?	Died from circulatory failure after peritoneum had been opened.	Carcinoma of rectum; secondaries in glands and liver. Atherosclerosis; coronary stenosis.	A very grave anaesthetic risk; local anaesthetic might have been a better choice.
No abnormal signs.	160	104·0	?	58	Pulse imperceptible at conclusion of operation (20 minutes). Death 10 minutes later from circulatory failure.	—	Extremely grave risk; but death due at least partly to local lesion.
No abnormal signs.	114	98·6	114/80	24	Died probably from circulatory failure, after 15 minutes. Operation not commenced.	—	Extremely grave risk; due partly due to anaesthetic, but reason obscure.
No abnormal signs.	140	98·6	160/110	24	Cyanosed throughout and died from respiratory failure at conclusion of operation.	Heart normal; lungs engorged; excess of pleural fluid. Subacute nephritis.	Death from renal failure with anuria; anaesthetic not a factor.
No abnormal signs.	100	98·4	?	?	Died quite suddenly after suture of dura, after two hours twenty minutes.	Frontal neoplasm; slight subarachnoid hemorrhage. Lung bases congested. Heart normal.	Death from shock, with respiratory failure of medullary origin.
No abnormal signs.	124	99·2	?	24	Died from sudden respiratory failure after 35 minutes. Blood transfusion was being given at the time.	Adenomyoma of uterus; blood cyst of ovary. Edema of glottis and lungs.	Death from asphyxia due to laryngeal edema; probably unavoidable.
No abnormal signs.	140	99·4	?	?	Vomited throughout operation; died from circulatory failure due to toxæmia and at conclusion of operation.	Acute general peritonitis, with ileus. Lungs congested. Heart normal.	A very grave risk. Local anaesthesia probably preferable to spinal.
Systolic murmur at all orifices.	104	100·2	?	?	Died from circulatory failure due to shock and hemorrhage shortly after return to ward.	No record.	Bad anaesthetic risk, owing to hemorrhage; anaesthetic rather a minor factor.

TABLE XIII.  
(The Royal Melbourne Hospital.)  
Analysis of 46,475 Anesthetics Administered to both Outdoor and Indoor Patients,  
Showing the Mortality Rate.

Anesthetic.	Number of Cases.	Number of Deaths.	Mortality Rate per centum.
Ethyl chloride	7,464	0	0
Ether	18,962	9	0·05
Chloroform	176	1	0·57
Nitrous oxide	2,158	12	0·56
Ethylene	481	1	0·21
Local	15,361	3	0·02
Spinal (and regional)	291	2	0·69
"Avertin", alone or with inhalational supplement	41	0	0
Intravenous barbiturates, alone or with supplement	544	0	0
Nature of anesthetic or of combination unspecified	997	0	0
Total	46,475	28	0·06

TABLE XIV.  
(The Women's Hospital, Melbourne.)  
Anesthetic Fatalities from January 1, 1932, to December 31, 1937.

Anesthetic.	Number of Cases.	Number of Deaths.	Mortality Rate.
Ether (all techniques)	207	1	0·483
Chloroform	7,921	3	0·036
Chloroform and ether	1,744	2	0·115
Nitrous oxide	93	2	2·151
Ethylene	6	—	—
Various and unspecified	174	—	—
Total	10,145	8	0·078

TABLE XV.  
(The Women's Hospital, Melbourne.)  
Details of Anesthetic Fatalities from January 1, 1932, to December 31, 1936.

Number.	Attempted Operation.	Anesthetic.	Clinical Condition.	Heart.	Urine.	Pulse Rate.
1	Forceps delivery.	Chloroform.	Previously, os dilated and membranes ruptured under sacral anaesthesia. General condition poor; much oedema; three or four fits before admission. Induction was thought preferable to Caesarean section.	Nothing abnormal detected. Sounds clear.	Albumin present.	134
2	Forceps delivery (head on perineum).	Nitrous oxide.	Poor. Two fits before admission.	?	Albumin present.	92
3	Attempted removal of placenta.	Nitrous oxide.	Pain in chest and dyspnoea for forty hours before admission; oedema.	?	Albumin in large amounts.	140
4	Manual removal of placenta.	Ether.	Post partum hemorrhage. Pulse rate up to 160. Uterus soft; no contractions felt.	Pulse rapid, of poor volume, not thready.	?	144
5	Forceps delivery.	Chloroform ether.	Difficult forceps case.	?	?	130
6	Laparotomy.	Chloroform ether.	Condition not good, but improved after transfusion of a pint of blood. Laparotomy was then decided upon.	No record.	?	?
7	Normal delivery.	Chloroform.	No details available.	No record.	?	?
8	Reposition of inverted uterus.	Chloroform.	Complete inversion of uterus; but, strangely, condition is described as good.	No record.	?	?

TABLE XVI.

(The Queen Victoria Hospital, Melbourne.)

Numbers of Occasions on which Various Anesthetics were Used in the Period 1932-1936.

Anesthetic.	Number of Cases.	Number of Deaths.
Ethyl chloride and open ether .. ..	1,777	0
Ether .. ..	825	1 <sup>1</sup>
Chloroform .. ..	9	0
Ethylene .. ..	91	0
Nitrous oxide and oxygen .. ..	65	0
"Sodium Evipan" .. ..	11	0
"Avertin" .. ..	306	0
Spinal .. ..	15	0
Local .. ..	148	0
Unspecified .. ..	4,466	0
Total .. ..	7,713	1

<sup>1</sup> The patient was a woman, aged twenty-five years, who was operated on for laceration of the perineum sustained during labour. She collapsed and died at the conclusion of the operation. The coroner gave as his verdict that death had been due to shock and haemorrhage following delivery. The anaesthetic was regarded as a minor factor only.

TABLE XVII.

(The Perth Hospital.)

Anaesthetic.	Number of Cases.	Number of Deaths.	Mortality Rate.
Ethyl chloride .. ..	5	—	%
Ether .. ..	5,378	14	0·26
Chloroform .. ..	39	1	2·564
Nitrous oxide .. ..	211	3	1·422
Ethylene .. ..	4	—	—
Cyclopropane .. ..	28	—	—
Regional and local .. ..	704	1	0·142
Spinal .. ..	735	4	0·544
"Avertin," alone or with inhalation supplement .. ..	23	—	—
Intravenous barbiturates ("Evipan Sodium" or "Penthal Sodium"), alone or with inhalation supplement .. ..	13	—	—
Unspecified .. ..	2,973	3	0·101
Total .. ..	10,113	26	0·256

NOTE.—In one case in which death occurred the risk was regarded as "A", in eight cases as "B", in eight as "C", and in nine as "D".

TABLE XV.

(The Women's Hospital, Melbourne.)

Details of Anesthetic Fatalities from January 1, 1932, to December 31, 1936.

Temperature.	Blood Pressure.	Stage at which Death Occurred.	Manner of Death.	Inquest.	Autopsy Findings.	Comment on Risk and Preventability.
° F. 98·4 rising to 180	162	Induction.	"Looked like cardiac failure."	Yes.	Chronic nephritis and cardiac dilatation. Mild toxæmia manifested in liver and other organs.	Apparently a grave risk (eclampsia).
99·6	160	Just after operation.	?	?	?	Eclamptic. Unconscious when admitted. Obviously a poor risk.
100·8	190	Induction.	"Took a few breaths, strangled and died."	?	?	Preeclamptic. Had received two previous nitrous oxide anesthetics since admission. Not a good risk.
98·2	86	During operation.	Possibly cardiac failure from extreme loss of blood.	?	?	A very poor risk on account of exsanguination.
97·4	138	During operation.	"Pulse and colour went off, followed by a gush of blood."	Yes.	Ruptured uterus.	Post mortem: Cesarean section. Dead child. Obstetrical shock, due to rupture of uterus, was obviously a big factor in causation of death.
?	?	Early in induction.	"Collapsed." No record of whether heart or respiration failed first.	Yes.	Extensive hydronephrosis of right kidney, with hemorrhage into sac.	First operation for hydronephrosis and retroperitoneal hemorrhage. Later, forceps when head on perineum. Second operation then decided upon. A poor risk. Perhaps should not be classed amongst midwifery deaths.
?	?	After cessation of anesthesia.	Cardiac failure.	?	Coronary embolism; cardiac failure.	No data available to form basis of comment on risk. Included in series only because death occurred shortly after administration of an anesthetic.
?	?	At end of the operation.	Cardiac failure.	?	?	Obstetric shock would certainly increase the anesthetic risk considerably. It is recorded that the uterus was replaced without difficulty and that, at conclusion of the operation, the pulse was imperceptible.

TABLE XVIII.

(The Perth Hospital.)

Number.	Diagnosis and Attempted Operation.	Age.	Sex.	Anesthetic Agent.	Clinical Condition.	Urine.	Heart.
1	Gall-stones, malignant disease of head of pancreas : Laparotomy.	67	F.	Spinal (2·0 cubic centimetres of 1 in 200 "Percain" solution).	Poor. Deep jaundice.	Bile present.	Enlarged cardiac failure.
2	Retention of urine : Suprapubic cystostomy.	63	M.	Spinal (13·0 cubic centimetres of 1 in 1500 "Percain" solution).	Poor.	Albumin and blood present.	No record.
3	Gastric ulcer : Laparotomy.	68	M.	Open ether and chloroform mixture (32 to 1), with carbon dioxide.	Emaciation. Fair condition.	Albumin present.	Enlarged.
4	Retropharyngeal abscess : Incision.	10 mths.	M.	Open ether.	In extremis ; ill two weeks ; dyspnoeic two days. Chest retraction.	No record.	No record.
5	Acute appendicitis ; general peritonitis : Appendicectomy.	14	F.	Open ethyl chloride and ether.	Apparently toxic and poor.	No record.	No record.
6	Secondary hemorrhage following a previous plastic operation to left axilla for contracting scar due to a burn : Ligation of bleeding vessels.	?	F.	No record.	In extremis from haemorrhage.	No record.	No record.
7	Carcinoma, left breast : Radical mastectomy.	45	F.	Open ethyl chloride and ether.	Apparently fair.	Normal.	No abnormal signs.
8	Mediastinal tumour : Rib and sterna resection for exposure.	39	M.	Endotracheal nitrous oxide and oxygen and ether.	Profoundly dyspnoeic from respiratory obstruction.	Normal.	Sounds faint ; otherwise nil abnormal.
9	General peritonitis from perforation of ulcerative colitis : Laparotomy.	30	M.	Open ethyl chloride and ether.	Very poor.	No record.	No record.
10	Left parietal cerebral tumour : Making of osteoplastic flap.	55	F.	Local.	Poor.	Trace of albumin.	Tachycardia.
11	Buerger's disease : secondary hemorrhage from deep epigastric artery following previous lumbar sympathectomy : Attempt to stop hemorrhage.	48	M.	Local and open ether and chloroform.	In extremis.	No record.	No record.
12	Buerger's disease : Cervical sympathectomy.	60	M.	Endotracheal ether.	Apparently good.	Nil abnormal.	Nil abnormal.

TABLE XVIII.  
(The Perth Hospital.)

Pulse Rate.	Temperature.	Blood Pressure.	Respiration Rate.	Time and Manner of Death.	Autopsy Findings.	Comment.
96	° F. 98.0	No record.	28	On delivery of gall-bladder. Respiratory followed by cardiac failure.	No record.	Prenarcosis consisted of morphine and hyoscine in a dose much too heavy for the patient's toxic condition and age. A spinal anaesthetic in this case was definitely contraindicated.
84	97.2	No record.	No record.	Twenty-five minutes after induction. Respiratory failure, followed by cardiac failure.	No record.	A local anaesthetic would probably have been more suitable than a spinal in this case.
72	97.0	No record.	20	Ten minutes after start of induction. Respiratory and cardiac failure almost synchronous.	No record.	The presence of even this dilute chloroform mixture with the increased respiratory exchange caused by the carbon dioxide might have resulted in a toxic dose of chloroform.
160	101.2	No record.	32	Death during manipulation before the abscess was opened.	No record.	Apparently death from circulatory failure of an extremely toxæmic patient.
No record.	No record.	No record.	No record.	On delivery of appendix, respiratory failure followed by cardiac.	Heart normal. Haemorrhage in pericardium from needle prick in resuscitation efforts. Fluid in peritoneum. Dongua's pouch full of turbid fluid.	Death from circulatory failure of a toxæmic patient.
No record.	No record.	No record.	No record.	Circulatory failure during attempt to stop hemorrhage.	Necrotic area in left breast and axilla. Thymus the size of a hen's egg. Dilated heart, flabby myocardium. Toxic degeneration of spleen. Kidneys congested.	Notes wholly inadequate. Apparently toxic absorption from necrotic area of attempted plastic. Secondary hemorrhage added another load to a poisoned myocardium, and circulatory failure followed.
88	98.2	No record.	20	Died half an hour after the finish of the operation.	No record.	Difficult to explain on evidence available.
112	97.0	Right arm : 140/90 Left arm : 130/90	20	On exposure and manipulation of tumour, sudden profuse haemorrhage from ruptured aortic aneurysm, with death in 100 seconds.	Large heart. Ruptured aneurysm of arch of aorta. Section of aorta showed syphilitic aortitis. Myocardial degeneration.	An operative and not an anaesthetic death.
120	97.0	No record.	24	Died within an hour of end of operation from circulatory failure.	No record.	Death from circulatory failure in a very toxæmic patient.
160	102.6	No record.	40	Died shortly after returning to ward.	Infiltrating tumour of left parietal lobe pressing on post-central gyrus about its middle.	Death apparently due to circulatory changes and shock.
120	103.0	No record.	28	Died shortly after return to ward.	Bronchopneumonia. Flabbiness of myocardium. Intestines dilated. Thromboangiitis of popliteal arteries.	Death from haemorrhage and shock preceded by bronchopneumonia and ileus.
80	97.0	No record.	20	On exposure of left stellate ganglion patient stopped breathing. Cardiac failure followed. After twenty minutes of trans-diaphragmatic and intraperitoneal massage heart began beating; it continued for forty minutes, and then finally stopped.	Gross atheroma, particularly of abdominal aorta and cerebral arteries. Old tuberculous changes in lungs and hilar glands. "In my opinion the blood supply to the brain was poor, so that respiratory and vital centres could not withstand the extra load of the operation and anaesthetic. Death was due to failure of respiratory centre primarily caused by gross vascular degeneration." (Extract from post mortem report.)	On the evidence the comment made by the pathologist's examination seems to be the only one possible.

TABLE XVIII.—Continued.  
(The Perth Hospital)

Number.	Diagnosis and Attempted Operation.	Age.	Sex.	Anesthetic Agent.	Clinical Condition.	Urine.	Heart.
13	Carcinoma of cervix uteri: Implantation of radium.	79	F.	Spinal ("Stovain").	Impossible to evaluate from notes. Sensility.	No record.	No record.
14	Carcinoma of rectum: Perineal resection.	64	M.	Spinal and nitrous oxide and oxygen.	Impossible to evaluate from notes.	Nil abnormal.	No record.
15	Cerebral abscess following mastoiditis: Drainage.	53	M.	Nitrous oxide and oxygen.	Very toxemic patient.	Nil abnormal.	Toxic myocarditis.
16	Carcinoma of penis; radium necrosis in right groin followed by severe haemorrhage from right femoral vessels: Attempt at ligature.	52	M.	Open ether.	In extremis from haemorrhage.	Nil abnormal.	Nil abnormal before haemorrhage.
17	General peritonitis from ruptured intestinal abscess: Laparotomy.	61	F.	Open ether.	Very poor.	No record.	No record.
18	Carcinoma of breast: Radical mastectomy.	50	F.	Ethyl chloride. Open ether.	?	Normal.	Normal.
19	Exophthalmic goitre: Thyroidectomy.	27	F.	Ethyl chloride. Open ether.	Fair; basal metabolic rate = +26%.	Normal.	Enlarged.
20	Post-tonsillectomy haemorrhage: Operation for haemostasis.	50	F.	Chloroform.	?	No record.	No record.
21	Pituitary tumour: Making of osteoplastic flap.	36	M.	Endotracheal ether.	Fair.	Normal.	Normal.
22	Appendicitis: Appendicectomy.	20	F.	?	?	Normal.	Normal.
23	Secondary malignant gland of neck: Excision.	54	M.	Endotracheal ether.	Fair.	Albumin present.	No record.
24	Exophthalmic goitre: Thyroidectomy.	24	F.	Basal "Avertin" and (?) nitrous oxide.	Fair; basal metabolic rate = +20% after treatment.	Normal.	Tachycardia.
25	Deviation of septum and sinusitis: Submucous resection of septum; double antrostomy.	48	M.	?	?	Normal.	Normal.
26	Cholecystitis: Cholecystectomy.	57	M.	Open ether.	?	Normal.	Normal.

TABLE XVIII.—Continued.  
(The Perth Hospital.)

Pulse Rate.	Temperature.	Blood Pressure.	Respiration Rate.	Time and Manner of Death.	Autopsy Findings.	Comment.
84	° F. 99·0	No record.	24	Death occurred twenty minutes after the intratracheal injection.	"Myocardial degeneration and failure. Carcinoma of cervix and lower uterine body... chronic degenerative nephritis. Long-standing myocarditis. Death due to heart failure. The degenerated myocardium long spoilt by cancer toxins could not withstand the extra load of operation manipulations." ( <i>Post mortem report.</i> )	The wisdom of the choice of a spinal anaesthetic at this age might be queried. Gas and oxygen would probably have been a better choice.
68	97·0	No record.	16	"Perineal resection of rectum was commenced and good progress made until patient began to complain and sigh. Nitrous oxide and oxygen were then given. Patient's condition went off markedly and operation was finished. Patient died before he could be removed from table." (Extract from operation notes.)	No record.	Death apparently due to circulatory failure from shock. The "complaint" voiced by the patient suggests that the spinal was either inadequate or had caused circulatory upset; but notes are too inadequate for one to be dogmatic as to causation.
102	100·4	No record.	20	Died apparently on the operating table.	"Suppurative labyrinthitis. Thickening of membranes. Pus over lateral sinus; slight softening of internal capsule... Dilated ventricles, soft myocardium. Spleen large... Kidneys engorged and toxic. Death from septicemia, following suppurative condition of labyrinth and cochlea." ( <i>Post mortem report.</i> )	Death apparently due to circulatory failure.
68	98·0	No record.	20	Died on return to ward.	Pulmonary tuberculosis.	Death due to severe hemorrhage, causing circulatory failure.
No record.	No record.	No record.	No record.	Died during induction of anesthesia.	No record.	Apparently a patient in <i>extremis</i> who died from circulatory failure during the induction of anesthesia.
80	97·6	No record.	20	Patient died twenty minutes after end of operation.	No record.	Cannot be explained on evidence.
84	98·4	No record.	20	Died three hours after operation.	No record.	Possibly a gas anaesthetic would have prevented death.
No record.	No record.	No record.	No record.	Apparently under anaesthetic.	Anthracosis of glands of hilum.	Apparently a chloroform death on the evidence.
86	98·0	No record.	20	Suddenly died at end when skin wound was half sutured.	No record.	Unexplainable on evidence.
104	99·4	No record.	20	"Appendicectomy. Patient went blue just before closing abdomen and all attempts at resuscitation failed to restore respiration." (Only available notes.)	No record.	Unexplainable on evidence.
94	98·0	No record.	24	"Dissection of gland of neck. Cessation of respiration and pulse under anaesthetic." (Notes.)	No record.	Unexplainable on evidence.
90	97·0	No record.	24	Died at end of operation one hour five minutes after start.	No record.	Operation was performed in the hot weather and too long an operating time was taken.
No record.	No record.	No record.	No record.	Died one hour twenty minutes after operation.	Autopsy showed no cause of death.	Unexplainable on evidence.
80	98·0	No record.	20	"D.O.T." (Only clinical note.)	No record.	Unexplainable on evidence.

TABLE XIX.  
(Prince Henry's Hospital, Melbourne.)  
Analysis of Individual Fatalities.

Case.	Diagnosis and Attempted Operation.	Anesthetic.	Clinical Condition.	Heart.	Urine.	Pulse Rate.	Blood Pressure in Millimetres of Mercury	Stage at which Death Occurred.	Manner of Death.	Inquest.	Autopsy Findings.	Comment on Anesthetic Risk and Preventability.	
1	Salpingitis : Salpingectomy.	A few drops of chloroform, followed by ether or ether (peribronchial inflation of morphine).	Healthy looking female aged 23 years. Pain in abdomen and vaginal discharge for eight months.	Nil abdominal.	Nil abdominal.	75	98-4	—	20 Induction.	Synopsis from cardiac dilation.	Held.	Operation necessary. No contraindication to general anaesthesia.	
2	Tonillitis, otitis media, septicaemia ; Paracentesis.	Open ether.	Pale pasty-looking child aged two years and seven months. Vomiting for two weeks. Right ear drum infected. Left bulging. Numerous rashes in lower part of chest.	—	Pus present.	172	103-0	—	44 During induction, after a few breaths.	Asphyxia due to inhalation of stomach contents. Milk drunk two hours before anaesthesia.	Held.	Toxicosis. Lungs congested. Trachea and bronchi contained soft stomach contents. Liver congested. No evidence of abscesses of brain or meninges. Middle ear reddening. Slight haemorrhage and pus in right ear.	
3	Infected sinuses ; tonsillitis. Double atresia.	Ethyl chloride (1.0 cubic centimetre) ; (24 ounces).	—	—	—	—	—	—	—	—	Cardio-respiratory failure.	Cavities of heart were dilated. Lungs moderately congested. Air passages contained frothy fluid. Small piece of bone in posterior part of pharynx.	
4	Cerebral tumour.	"Novocain" in 0.5% solution.	Female.	Enuresis.	No abnormal constituent.	—	—	—	—	—	Hyperpyrexia. Post-operative shock.	Not held.	General anaesthesia suitable. There was no contraindication to ether.
5	Pyelonephritis : Cystoscopy.	Nitrous oxide and oxygen.	Female aged four and a half years. Had cystoscopy under general anaesthesia three weeks previously.	Apx beat in 5th space outside nipple line.	Loaded with pus.	140	98-4	—	35	Died after operation and before return to ward.	Circulatory failure.	Not held.	Death probably unavoidable. Appropriate suitable anaesthesia for a child of this size. Death due to probable cardiovascular adhesions. Mitral valve cause thickened. Hydrostatic congestion of 1 in 5. 8 m a 11 quantity of free fluid in abdomen. Liver enlarged, spleen enlarged, fibrous.
6													Death due to probable cardiovascular disease.

TABLE XIV.—Continued.  
(Prince Henry's Hospital, Melbourne.)  
Analysis of Individual Fatalities.

Case.	Diagnosis and Attempted Operation.	Anesthetic.	Clinical Condition.	Heart.	Urine.	Pulse Rate.	Blood Pressure in Millimetres of Mercury.	Stage at which Death Occurred.	Manner of Death.	Inquest.	Autopsy Findings.	Comment on Anesthetic Risk and Preventability.
6	Cerebral abscess; meningitis; exploratory operation.	Preliminary medication with one-third grain of "Omnopon" and one-one hundred and fifth grain of "Novocaine" and "Avertin".	Healthy-looking woman, aged 40 years.	Aconitatoxicated sottic second sound.	Nil abnormal.	85	97° F 97° 0	163/90	24	About three hours after operation.	No report.	Anesthetic suitable for operation. Serious risk and probably death not preventable.
7	Intestinal obstruction: abdominal operation.	Nitrous oxide and oxygen.	Child, aged four and a half years.	Abdominal pain for one day.	Drowsiness, vomiting, diarrhea.	—	—	—	Disturbance of brain tissues; post-operative shock.	Not held.	—	Serious anesthetic risk. Nitrous oxide and oxygen suitable supporting a general anaesthetic was required. Probable death was unpreventable, due to toxemia and shock.

TABLE XX.

(Prince Henry's Hospital, Melbourne.)  
Deaths under Anesthesia during the Period 1932-1936.

Anesthesia.	Number of Cases.	Number of Deaths.	Mortality Rate.
Ether	3,279	2 <sup>a</sup>	0·054
Chloroform	2 <sup>a</sup>	—	1·163
Nitrous oxide	172	—	—
Ethylene	6	—	—
Regional and local	211	1	0·474
Spinal	160	1	—
"Avertin" alone	12	—	—
"Avertin" supplemented	1	—	—
Barbiturates (intravenously)	10	—	—
Total	3,843	6	0·156

<sup>a</sup> In one instance a few drops of chloroform were used.

NOTE.—One fatality occurred in 6,037 minor operations on out-patients—a mortality rate of 0·017%.

TABLE XXI.

(The Adelaide Children's Hospital.)

Fatalities on the Operating Table before the Patient had Recovered from the Effects of the Anesthetic (October, 1931, to September, 1932).

Anesthetic.	Number of Cases.	Number of Deaths.	Percentage Mortality.	Death Rate.
Ethyl chloride	3,184	—	—	—
Ether (includes induction with ethyl chloride, nitrous oxide and chloroform)	12,813	8	0·0624	1 in 1,602
Chloroform	52	—	—	—
Nitrous oxide	602	—	—	—
Ethylene	20	—	—	—
Regional and local	1,190	—	—	—
Spinal	4	—	—	—
"Avertin"—	—	—	—	—
Alone	129	—	—	—
With an inhalational supplement	22	—	—	—
Barbiturates (intravenously)	64	—	—	—
Total	18,080	8	0·044	1 in 2,260

TABLE XXII.

(The Adelaide Children's Hospital.)

Relative Frequency and Mortality Rates of Three Common Operations in which 75% of the Deaths Occurred.

Operation.	Number.	Percentage of Total Operations.	Deaths.		
			Number.	Percentage.	Rate.
Tonsillectomy	5,850	32·3	2	0·034	1 in 2,925
Cleft palate	45	0·25	—	4·4	22·5
Mastoidectomy	425	2·34	—	0·47	212·5

TABLE XXIII.

(The Adelaide Children's Hospital.)  
*Analysis of Individual Fatalities.*

Number.	Diagnosis and Attempted Operation.	Age in Years.	Sex.	Premedication.	Anesthetic.		Surgical Risk.	Clinical Condition.
					Induction.	Maintenance.		
1	Cleft palate : Repair.	5 2— 12	M.	Atropine (1/200 grain).	Ethyl chloride.	Ether by intrapharyngeal insufflation.	B	Healthy child ; had ethyl chloride for teeth extraction five weeks before.
2	Enucleation of tonsils and adenoids.	8 3— 12	M.	Atropine (1/150 grain); calcium lactate; glucose.	Ethyl chloride.	Ether by oral insufflation.	B	Unhealthy child ; attended out-patient department for frequent cough and vomiting. Recently had ethyl chloride twice for teeth. Operation put off several times.
3	Cleft palate : Repair.	3 2— 12	M.	Atropine (1/150 grain).	Ethyl chloride (about 3·0 cubic centimetres—open).	Ether by intrapharyngeal insufflation.	B	Healthy child. At three months had "Avertin", chloroform and ether for operation to lip ; at one year and eight months had ether for palate operation.
4	Acute mastoiditis : Cortical mastoidectomy.	6	F.	Atropine (1/150 grain); glucose.	Chloroform and ether, equal parts.	Ether by intrapharyngeal insufflation, Hewitt's air-way.	D	A seriously ill child, suffering from acute septic infection.
5	Mastoiditis : Mastoidectomy.	8 11— 12	F.	"Nembutal" (0·15 gramme); atropine (1/100 grain).	Chloroform and ether equal parts.	Ether by intrapharyngeal insufflation, Hewitt's air-way.	B	Healthy child ; well developed, approaching puberty ; both antra opaque to X rays. Had ethyl chloride for tonsils and adenoids six weeks before.
6	Sinusitis : Double antrostomy; enucleation of tonsils and adenoids.	4 6— 12	F.	Atropine (1/100 grain).	Ethyl chloride.	Ether by intratracheal insufflation for antrostomy; intraoral, by Davis-Boyle gag for tonsils.	B	Healthy child ; X rays showed some opacity of antra.
7	Cut foot : Suturing of tendons.	3	M.	Atropine (1/150 grain).	Ethyl chloride.	Open ether.	B	Healthy child ; five previous general anaesthetics, one for tonsilectomy. Said to have been four hours without food.
8	Aneurysm of cerebral arteries : Exposure of both internal carotid arteries for injection of "Thorotrast".	9	M.	No note.	Ethyl chloride. (Did not take the following ether smoothly).	Ether by intratracheal insufflation.	B	Comatose on admission ; conscious before operation. Slept badly. Chronic nasal discharge ; bronchitis five previous general anaesthetics.

TABLE XXIII.

(The Adelaide Children's Hospital.)  
*Analysis of Individual Fatalities.*

Urine.	Heart.	Pulse Rate.	Respiration Rate.	Temperature.	Time and Manner of Death.	Resuscitation Methods Used.	Autopsy Findings.	Comments.
Not examined.	Normal.	136	40	° F. 96.8	During operation, thirty-six minutes induction, respiration gradually failed, then circulation stopped.	Artificial respiration; O <sub>2</sub> with 7% CO <sub>2</sub> , poured into pharynx; heart massage; 0.5 cubic centimetre of adrenaline solution into heart.	Not done.	Probably overdose of ether; anoxæmia due to inhaled blood. Possibly shock or some unknown condition.
Normal previously.	Normal.	—	—	96.8	Ten minutes after start, operation nearly finished. Respiration stopped.	Artificial respiration; O <sub>2</sub> with 7% CO <sub>2</sub> , run into trachea and pharynx. Pituitrin (1 cubic centimetre), strychnine (1/150 grain) and adrenaline solution (0.3 cubic centimetre) injected into heart.	Lungs: increase of interstitial tissue. Thymus—62 grammes (mean, 26 grammes for age-group one to six years).	Possibly operative shock and vagal inhibition, with overdose of ether. This child may be of a type with poor resistance to shock. The operator was a junior.
Normal.	Normal.	120	26	98.2	Shortly after start of operation, twenty minutes from induction. Cyanosis; respiration stopped, started again. Circulation stopped.	Artificial respiration; O <sub>2</sub> with CO <sub>2</sub> , run into pharynx. Heart massage. Adrenaline and pituitrin injected into heart.	Not done.	Uncertain; perhaps shock. Heart massage successful here to the extent of causing some consecutive auricular beats, with feeble ventricular beats, giving oxygenation of the blood and contraction of pupils.
Acetone + + +	Normal.	108	24	99.2	During operation, twenty-five minutes after induction, respiration became shallow; stopped two minutes later. Heart stopped in two more minutes.	Artificial respiration; O <sub>2</sub> run into pharynx. Strychnine (1/100 grain), "Coramine" (1.0 cubic centimetre) injected into heart. Heart massage.	Infection of mastoid; external abscess extended forward to zygoma. Toxic swelling of heart muscle, liver, kidneys and spleen.	Shock with possibly overdose of ether; enfeebled subject.
Normal.	Normal.	90	24	98.0	Anesthetic had just been stopped, forty minutes from start of operation. In three minutes respiration stopped suddenly; heart stopped soon afterwards.	Artificial respiration; O <sub>2</sub> and CO <sub>2</sub> run into pharynx. Adrenaline given intramuscularly and into heart. "Coramine" (1.0 cubic centimetre) injected into heart. Heart massage.	Organs appeared normal. Thymus—34 grammes (mean, 33.9 for age-group 11-16 years).	Probably overdose of ether or respiratory centre depressed by "Nembutal".
Normal.	Normal.	—	—	97.0	Five minutes after operation, nurse in recovery room reported pulse could not be felt.	Artificial respiration; O <sub>2</sub> and CO <sub>2</sub> given intratracheally. Adrenaline and "Coramine" injected into heart.	Not done.	Probably obstruction to respiration by tongue falling back, anesthesia being still deep.
Not examined.	Normal.	104	—	97.0	About one hour from start; operation just finished. Patient began to come round. Vomited food, pieces of apple. Respiration stopped, and heart immediately afterwards.	Artificial respiration; O <sub>2</sub> and CO <sub>2</sub> , run into pharynx, later into trachea. Adrenaline and "Coramine" given intramuscularly and intracardially. Heart massage through parieties.	Not done.	Probably mechanical asphyxia. Difficult cases to handle, when effect of gravity and cough fail to remove obstruction. Immediate bronchoscopy rarely available.
Normal.	Normal.	104	24	97.0	During operation, fifty minutes after start; breathing had been jerky, pupils large. Respiration became shallow, heart feeble; both stopped.	Artificial respiration; O <sub>2</sub> and CO <sub>2</sub> , run into trachea. Adrenaline injected into heart. Cisterna magna puncture. Heart massage.	Fair amount of muco-purulent secretion in bronchi and smaller tubes. No cerebral aneurysms; section showed nothing abnormal.	Possibly overdose of ether and airways partly blocked by secretions, contributed to by patient's not having had atropine.

TABLE XXIV.  
(The Royal Prince Alfred Hospital,  
Deaths under Anesthesia (July 1, 1936, to June 30, 1937.)

Number of Case.	Anesthetic.	Age.	Suitability for Anesthesia.	Operation.	Duration in Minutes.	Pneumostatic Medication.	Efforts to Revive.	Remarks and Suggested Cause of Death.
1	Open ether.	63	Symptoms of slight cardiac failure.	Laparotomy for carcinoma.	5	NIL.	Artificial respiration. Cardiac massage. Intracardiac adrenalin injection.	"Pulse and respiration failed suddenly, due to cardiac failure or peritoneal shock."
2	Open ether.	22	Tuberculous peritonitis; pulmonary tuberculosis.	Laparotomy and drainage; division of adhesions; appendicectomy.	160	NIL.	Died on return to ward; 1.0 cubic centimetre of pituitrin given.	Operative shock.
3	Open ether.	62	Apparently healthy.	Osteotomy of femur; plating.	116	NIL.	Intravenous injection of 500 ml. saline solution, pituitrin, strychnine. Intracardiac adrenalin injection.	"Considerable hemorrhage and hardening of bone." Operative shock.
4	Open ether.	50	Symptoms and signs of cardiac failure and hypostatic constipation.	Cholecystotomy (immediate) for empyema of gall-bladder.	25	NIL.	1/20 grain of strichnine hydrochloride.	Cardiac failure.
5	Open ether.	44	Systolic murmur.	Appendicectomy. (Ruptured appendix and general peritonitis.)	?	NIL.	Artificial respiration; intratracheal insufflation.	Either cardiac failure or operative shock.
6	Open ether.	3	Pulse rate 170 before operation.	Incision for osteomyelitis of femur.	5	NIL.	Artificial respiration. Pituitrin intramucillary; adrenalin intracardiac.	Cardiac failure.
7	Open ether.	65	Pulmonary tuberculosis. "Very sick."	Laparotomy. (Carcinoma of colon; general peritonitis.)	25	NIL.	Not recorded.	Cardiac failure.
12	Open ether.	66	Apparently healthy.	Bone graft for ununited fracture of tibia.	90	NIL.	Not recorded.	"Died thirty minutes after leaving theatre, without regaining consciousness." Operative shock.
13	Open ether.	36	Apparently healthy.	Tooth extraction. (Had carcinoma of floor of mouth.)	10	NIL.	Not recorded.	No information recorded as to mode of death.
16	Open ether.	36	Obese. Symptoms of cardiac failure.	Total hysterectomy; double salpingectomy and oophorectomy for uterine fibroids.	90	NIL.	Artificial respiration; intratracheal oxygen. Strychnine. Intracardiac injection of adrenalin.	Cardiac failure or operative shock.
24	Open ether.	60	Very pale. Haemoglobin value = 36%.	Gastroenterotomy for carcinoma of stomach.	?	NIL.	Artificial respiration. Intratracheal insufflation. Cardiac massage.	Preliminary blood transfusion might have been wise.
25	Open ether.	7	Apparently healthy.	Open reduction of congenital dislocation of hip.	90	NIL.	Artificial respiration.	Operative shock.

TABLE XXIV.—Continued.  
(The Royal Prince Alfred Hospital.)  
Deaths under Anesthesia (July 1, 1924, to June 30, 1931).

Number of Case.	Anesthetic.	Age.	Suitability for Anesthesia.	Operation.	Duration in Minutes.	Peanesthetic Medication.	Efforts to Revive.	Remarks and Suggested Cause of Death.
26	Open ether.	11	<i>Amiodontia congenita.</i>	Manipulation of feet.	30	Nil.	No remarks.	"Condition good when leaving theatre, died fifteen minutes after return to ward." Notes insufficient. Airway may have been blocked.
29	Open ether.	6	Apparently healthy.	Bone graft for ununited fracture of ulna.	60	Nil.	Artificial respiration, "Stimulants."	Operative shock.
30	Open ether.	40	Apparently healthy.	Total hysterectomy and double salpingectomy for fibroids.	130	Nil.	Artificial respiration, Intra-tracheal oxygen, Strychnine and pituitrin.	Operative shock.
32	Open ether.	2	Lobular pneumonia.	Exploration of chest.	15	Nil.	Artificial respiration. Pituitrin.	Cardiac failure or operative shock.
27	Ether with carbon dioxide.	50	Apparently healthy.	Enucleation of cervix and pelvic section for chronic metritis.	75	Nil.	Artificial respiration, Intra-tracheal oxygen. Cardiac massage, Intracardiac adrenaline injection.	"In the opinion of those present, death was due to cardiac failure."
8	Intratracheal ether.	20	Bronchiectasis.	Double intranasal antrostomy for chronic maxillary sinusitis.	40	Nil.	Artificial respiration, Intra-tracheal insufflation, Pituitrin. Intracardiac adrenaline.	"Patient became blue and condition went off. No obvious blockage of airway." Possibly asphyxia due to inhaled clot.
11	Intratracheal ether.	62	Apparently healthy.	Resection of half of mandible for epithelioma of tongue.	90	Atropine (1/100 grain) hypodermically.	Artificial respiration.	Operative shock.
15	Intratracheal ether.	76	Apparently healthy.	Excision of malignant glands of neck.	10	Atropine (1/100 grain) hypodermically.	Artificial respiration.	Notes insufficient.
19	Intratracheal ether.	59	Encephalitis.	Radical antrostomy for chronic maxillary sinusitis.	20	Atropine (1/100 grain) hypodermically.	Artificial respiration, Strychnine, pituitrin. Intracardiac injection of adrenaline.	"Patient was white, not blue." Probably cardiac failure.
21	Intratracheal ether.	69	No cardiac symptoms.	Nephrectomy for calculus, pyonephrosis.	50	Atropine (1/100 grain) hypodermically.	No remarks.	Possibly operative shock.
22	Intratracheal ether.	55	Dyspnoea on exertion.	Partial thyroidectomy for exophthalmic goitre.	60	Atropine (1/100 grain)	Artificial respiration. Pituitrin. No remarks.	"Left theatre with stitch in tongue, died suddenly in ward." Notes insufficient.
23	Intratracheal ether.	58	Apparently healthy.	Laparotomy for chronic cholecystitis.	?	Atropine (1/100 grain) hypodermically.	Artificial respiration. Pituitrin. Intracardiac adrenaline injection.	"Bad induction, condition went off, improved, then went off again." Cardiac failure.

TABLE XXIV.—Continued.  
 (The Royal Prince Alfred Hospital.)  
*Deaths under Anesthesia (July 1, 1934, to June 30, 1937).*

Number of Case.	Anesthetic.	Age.	Suitability for Anesthesia.	Operation.	Duration in Minutes.	Preatesthetic Medication.	Efforts to Revive.	Remarks and Suggested Cause of Death.
28	Intratracheal ether.	45	Apparently healthy.	Radical antrostomy for chronic maxillary sinusitis.	20	Atropine (1/100 grain) hypodermically.	Artificial respiration. Tracheal intubation. Strychnine. Pitultrin.	"Condition good at end of operation. Five minutes later, suddenly 'blue.' Airway blocked; possibly inhalation of blood clot."
14	Intrapharyngeal ether.	63	Apparently healthy.	Excision of glands of neck. Carcinoma of tonsil.	90	Atropine (1/100 grain) hypodermically	No notes.	"Left theatre in good condition, pulseless on arrival in ward; died a few minutes later. Either cardiac failure or operative shock."
9	Intratracheal ether succeeded by intrapharyngeal ether.	29	"Weakness."	Partial thyroidectomy. Toxic adenoma.	NIL	5 Intratracheal. 15 Intrapharyngeal.	Artificial respiration.	"Difficult to intubate, then catheter slipped out, and was replaced by intrapharyngeal intubation.... There appeared to be some respiratory embarrassment and cardiac failure."
17	Ethylene and oxygen.	25	Bronchictasis.	Thoracotomy.	12	Morphine (1/6 grain) and stryptone (1/100 grain).	Artificial respiration. Pitultrin.	Possibly pleural shock.
31	Chloroform.	60	Very pale. Haemoglobin value = 25%.	Excision by diathermy of spindle-celled sarcoma of abdominal wall.	20	NIL	Artificial respiration. Intra-tracheal intubation. Pitultrin, strychnine.	"Patient suddenly stopped breathing." Possibly cardiac failure. Preliminary blood transfusion might have been wise, in view of low haemoglobin value.
10	Local.	17	Very sick. General peritonitis and empyema.	Blood transfusion.	20	NIL	No notes.	"Patient became strange and cried out several times." Possibly coronary embolism, possibly incompatible blood.
18	Local.	17	Apparently healthy.	Attempted excision of cyst of nasal region.	7	Morphine (1/4 grain) one hour before operation.	Artificial respiration. Intra-tracheal oxygen. Pitultrin. Adrenaline by intracardiac injection.	Four ounces of 1% "Novocain" solution and four minims of adrenaline solution had been used, when patient's colour, pulse and respiration began to deteriorate. In the opinion of those present, death was due to an idiosyncrasy to either adrenaline or "Novocain".
20	Local.	43	Very low.	Treotomy (intestinal obstruction).	10	NIL	No remarks.	"Novocain" used. Death appears to have been due to the abdominal condition rather than to the operation or anesthetic.

(Note.—Of the three deaths under local anesthesia, the second is the only one in which it seems likely that the local anesthetic was partly or wholly responsible.)

TABLE XXXV.  
(Saint Vincent's Hospital, Sydney.)  
Details of Anesthetic Fatalities (1932-1936).

Patient's Age.	Diagnosis.	Operation.	Premedication.	Anesthetic.	Clinical Condition.	Heart.	Urine.	Pulse Rate.	Temperature.	Blood Pressure in Millimetres of Mercury.	Respiratory Rate.	Stage at which Death Occurred.	Mode of Death.	Autopsy Findings.	Comment.
52	Primary thyrotoxicosis.	Thyroidectomy.	Atropine (1/100 grain half an hour before operation.	Ethyl chloride and ether open intratracheal tube.	Good.	Normal.	Normal.	76	97.8° F.	148/108	20	At commencement of operation.	Circulatory failure.	Not done.	Skin incision was made and it was noticed that there was no bleeding. It is debatable whether the best anaesthetic was used in this case.
17	Chronic tonsillitis and deviated nasal septum.	Tonsillectomy.	Atropine (1/100 grain).	Open ether, followed by intratracheal ether through a Mc Gills' tube.	Excellent.	Normal.	Normal.	72	97.8°	Not taken.	20	During operation.	Cardiac failure.	Not done.	Breathing was noticed to be irregular. Pulse became almost imperceptible, becoming in 30 seconds or so impalpable. Patient gave three or four gasping respirations. Very difficult to explain this.
43	Cholecytectomy.	Cholecytectomy.	Atropine (1/100 grain).	Open ether.	Fair.	Normal.	Contained bile.	88	98.0°	Not taken.	20	Gall-bladder had just been exposed and aspirated.	Respiratory failure.	Not done.	A fair anaesthetic risk; death probably due to shock.
36	Compound fracture of tibia fractured femur.	Division of wound.	Morphine (1/4 grain) and atropine (1/100 grain) one hour before operation.	Open ether.	Fair, recovering from shock.	Normal.	Trace of albumin.	88	97.0°	Not taken.	20	End of operation.	Respiratory failure.	Not done.	This patient had deep convulsions when the appendix was located. Artificial respiration was performed. Adrenalin, strichnine and digitalin were injected. The anaesthetic risk appeared to be excellent.
18	Acute appendicitis.	Appendectomy.	—	Open ether.	Good.	Normal.	Trace of albumin.	100	99.6°	Not taken.	20	During operation.	Respiratory failure.	Not done.	This patient had deep convulsions when the appendix was located. Artificial respiration was performed. Adrenalin, strichnine and digitalin were injected. The anaesthetic risk appeared to be excellent.
45	Renal calculus.	Nephrectomy.	—	Open ether.	Poor.	Normal.	Blood present.	120	99.2°	Not taken.	20	During operation.	Circulatory failure from renal hemorrhage.	Not done.	Death was due to rapid and brisk hemorrhage from the renal pedicle. The kidneys were very edematous and it was impossible to control the hemorrhage. Nephrectomy performed twelve days previously; severe haematuria three days previously. Operation was undertaken urgently.
50	Carcinoma of oesophagus.	Oesophagostomy and implantation of radium.	—	Open ether followed by intranasal ether.	Fair.	Normal.	Normal.	80	97.2°	Not taken.	20	During operation.	Circulatory failure.	Not done.	The oesophagostomy had been passed and radium inserted. At this stage the pulses, which had been of good volume, though slow, became very weak. Respiration became shallow. Heart then ceased.

\* During a period of two weeks at this time there were three cases of deep ether convulsions; analysis of the ether revealed no impurities.

TABLE XXV.—Continued.  
(Saint Vincent's Hospital, Sydney.)  
Details of Anesthetic Fatalities (1882-1936).

Patient's Age.	Diagnosis.	Operation.	Premedication.	Anesthetic.	Clinical Condition.	Heart.	Urine.	Pulse Rate.	Blood Pressure in Millimetres of Mercury.	Respiratory Rate.	Stage at which Death Occurred.	Mode of Death.	Autopsy Findings.	Comment.
39	Compound fracture of the tibia; osteomyelitis.	Amputation of leg.	—	Nitrous oxide and oxygen.	Extremely poor.	No enlargement; sounds toneless.	Normal.	134	90-8° F.	Not taken.	24	During operation.	Circulatory failure.	Not done. An extremely poor anesthetic risk.
64	Carcinoma of the pancreas.	Cholecystectomy.	Morphine (1/4 grain) repeated in three-quarters of an hour.	"Novocain" (1% solution) followed by nitrous oxide and oxygen.	Very jaundiced. Breathless on moderate exertion.	Systolic murmur at mitral and aortic areas.	Contained bile.	72	97-4° F.	184/132	20	At completion of operation.	—	Not done. Poor anesthetic risk. Local anaesthetics might have been selected.
63	Carcinoma of the ovary and intestinal obstruction.	Colectomy.	—	Nitrous oxide and oxygen.	Very poor.	Myocarditis.	Normal.	128	97-0° F.	Not taken.	20	At completion of operation.	Circulatory failure.	Not done. Intestinal obstruction had persisted for six days. Operation was undertaken urgently.
66	Carcinoma of the tongue.	Insertion of radium.	Morphine (1/4 grain), atropine (1/100 grain) half an hour before operation.	Open ether followed by intratracheal ether.	Poor. Emaciated; ulcerated tongue.	Normal.	Normal.	100	97-0° F.	Not taken.	20	At completion of operation.	Circulatory failure.	Not done. Poor clinical risk on account of condition of mouth and emaciation.

TABLE XXVI.  
(The Children's Hospital, Perth.)  
Analyses of Individual Fatalities.

Case Number.	Diagnosis and Attempted Operation.	Anesthetic.	Clinical Condition.	Heart.	Urine.	Pulse.	Temperature.	Respiratory Rate.	Stage at which Death Occurred.	Manner of Death.	Autopsy Findings.	Comment on Anesthetic Risk and Preventability.
1	Cleft palate: Repair.	Ethyl chloride and intranasal ether.	Good.	Normal.	Normal.	96.	Normal.	30	During operation.	—	Very large thymus; other organs healthy.	Presumably not preventable.
2	Tuberculous cervical adenitis: Division of tonsil rese.	Ethyl chloride and endotracheal ether.	Good.	Normal.	Normal.	110	Normal.	22	Ten minutes after operation.	Sudden, Probable vagal spasm.	Heart small and contracted; other organs healthy.	—
3	Intestinal obstruction from Meckel's diverticulum: Laparotomy.	Ethyl chloride and ether.	Poor.	Normal.	Normal.	Almost imperceptible.	96° F.	Not recorded.	At sewing up of wound.	Cardiac failure.	No autopsy done.	Four days' history of intestinal obstruction, which rendered this case a poor risk.
4	Hydrocephalus: Ventriculography.	Ethyl chloride and ether.	No record.	Normal.	Normal.	120.	Normal.	28	Not recorded.	Cardiac failure.	No autopsy done.	—

TABLE XXXVII.  
(The Children's Hospital, Melbourne.)  
Details of Sixteen Anesthetic Fatalities during the Period 1933-1937.

Patient.	Diagnosis.	Attempted Operation and Anesthetic.	Clinical Condition.	Heart.	Pulse Rate.	Temperature.	Stage at which Death Occurred.	Manner of Death.	Autopsy Findings.	Comment on Anesthetic Risk and Pre-ventilability.
1. M.M.	Atrial sinusitis.	Autotomy; CO, and O.E.	Some cardiac insufficiency.	Slight dilatation.	Not recorded.	* F. Not recorded.	Induction.	Circulatory failure.	Right side of heart dilated.	"B" risk. Use of CO, for induction a probable factor. Possibly preventable.
2. W.S.	Spastic diplegia.	Tentomy; O.E.	Very poor physical and mental development.	N/I abnormal.	80	98.4	During operation.	Circulatory failure.	Right heart failure.	"B" risk. Probably unavoidable.
3. P.D.	Retropharyngeal abscess.	Incision; O.E.	Large abscess. Small child. Toxemic.	N/I abnormal.	110	101.0	Induction.	Circulatory failure.	Toxemia marked. Large abscess. Anesthetic a minor factor.	"D" risk. Probably unavoidable.
4. R.D.	Appendiceal abscess (7th day).	Appendectomy; O.E.	Toxemic.	N/I abnormal.	112	100.0	During operation.	Circulatory failure.	Not traced.	"C" risk. Possibly preventable.
5. F.D.	Intraabdominal gangrene.	Reduction; resection; O.E.	Shock and toxemic.	N/I abnormal.	140	97.0	During operation.	Circulatory failure.	None.	"D" risk. Probably unavoidable.
6. D.A.	Harelip.	Repair of lip; I.N.E.	Good.	N/I abnormal.	80	98.0	During operation.	Respiratory failure.	Death due to asphyxia from respiratory paralysis. Frothy fluid and blood-stained mucus in right bronchus.	"A" risk. Frankly preventable.
7. E.V.	Cleft palate.	Repair; I.N.E.	Good.	N/I abnormal.	90	98.0	During operation.	Respiratory failure.	Not traced.	"A" risk. Frankly preventable.
8. R.M.	Pontine tumour.	Exposure; cerebellar decompression; I.T.C.	Poor.	N/I abnormal.	70	98.4	During operation (before dura was opened).	Respiratory failure.	Pontine tumour. Respiratory paralysis. Anesthetic a minor factor.	"D" risk. Unavoidable.
9. J.C.	Cerebral tumour.	Exposure; cerebellar decompression; I.T.C.	Fair.	N/I abnormal.	80	97.0	During operation (haemorrhage from sinus).	Circulatory failure.	Pontine tumour. Anesthetic no effect.	"D" risk. Unavoidable.
10. G.P.	Bronchiectasis.	Lipiodol injection; Chlo. and O.E.	Poor. Advanced tracheostasis.	Dilated.	Not recorded.	Not recorded.	During operation.	Circulatory failure.	Cardiac dilatation. Gross bronchiectasis. Anesthetic a minor factor.	"C" risk. Possibly unavoidable.
11. A.M.	Suppurative arthritis of hip.	Arthroscopy; N,O and O <sub>2</sub> .	Pericarditis. Very poor.	Pericarditis.	140	103.0	During operation.	Circulatory failure.	Septicemia and septic pericarditis.	"B" risk. Unavoidable.

NOTE.—O.E. = Ether administered by the open method.

I.N.E. = Ether administered intranasally.

I.T.C. = Ether given intratracheally.

Chlo. = Chloroform. Records of the results of urine examination and blood pressure estimations and the pulse and respiration rates were not available. An request was not held in any case.

TABLE XXVII.—Continued.  
(The Children's Hospital, Melbourne.)  
Details of Sixteen Anesthetic Facilities during the Period 1932-1937.

Patient.	Diagnosis.	Attempted Operation and Anesthetic.	Clinical Condition.	Heart.	Pulse Rate.	Temperature.	Stage at which Death Occurred.	Manner of Death.	Autopsy Findings.	Comment on Anesthetic Risk and Perioperatively.
12. F.L.	Acute osteomyelitis of tibiae.	Ligation; N <sub>2</sub> O and O <sub>2</sub> .	Very poor.	Nill abnormal.	140	101.0	After operation.	Circulatory failure.	None.	"D" risk, Probably unavailable.
13. I.M.	Cardiosus of suprarenals.	Laparotomy; N <sub>2</sub> O and O <sub>2</sub> .	Poor.	Dilated.	Not recorded.	Not recorded.	During operation.	Circulatory failure.	Not traced.	"D" risk, Possibly unavailable.
14. M.L.	Osteomyelitis of femora and pelvis.	Plaster spica change; N <sub>2</sub> O and O <sub>2</sub> .	Very poor. Toxicemic.	Dilated.	140	101.0	During operation.	Circulatory failure.	None.	"D" risk, Probably unavailable.
15. D.W.	Intestinal obstruction following trauma (4th day).	Laparotomy; ethylene.	Severe degree of shock.	Nill abnormal.	150	99.0	During operation.	Circulatory failure.	None.	"D" risk, Probably unavailable.
16. A.B.	Intussusception (4th day).	Reduction; spinal shock.	Severe degree of shock.	Nill abnormal.	140	?	After operation.	Circulatory failure.	Severe intussusception reduced. Peritonitis.	"D" risk, Probably unavailable.

NOTE.—O.N.E. = Ether administered by the open method.  
I.N.E. = Ether given intranasally.  
I.T.E. = Ether given intratracheally.  
C.H.O. = Chloroform.

Records of the results of urine examination and blood pressure estimations and the pulse and respiration rates were not available. An inquest was not held in any case.

TABLE XXVIII.  
(The Children's Hospital, Melbourne.)  
Anesthetic Fatalities among In-Patients in The Children's Hospital, Melbourne, during the Period 1932-1937.

Anesthetic.	Number of Cases.	Deaths.	Percentage Age.
Ethyl chloride	5	0	0
Ethyl chloride followed by open ether	1,095	0	0
Carbon dioxide and open ether	241	0	0
Open ether	2,703	4	1.5
Intranasal ether	885	2	0.24
Ether with Davis gag	74	0	0
Intratracheal ether	24	0	8.3
Chloroform	17	0	0
Chloroform plus open ether	4	0	0
Nitrous oxide plus oxygen	533	4	0.7
Ethylene	13	1	7.8
"Avertin".			
(a) Alone	14		
(b) With "Omnopon".	3		
(c) With nitrous oxide	1		
Spinal	5	1	20.0
Paraldehyde	10	0	0
Paraldehyde plus ether	9		
Local	173	0	0
Total	5,809	14	0.24

Note.—In 18,000 cases there were two deaths during anesthesia for minor operations on out-patients.

TABLE XXIX.  
Anesthetic Mortality in 193,977 Cases at Eight Hospitals.

Hospital.	Type of Case.	Number of Cases.	Number of Deaths.	Deaths per Thousand.
The Alfred	General.	28,313	22	0.77
The Royal Melbourne	General.	46,475	28	0.60
The Women's	Midwifery	10,142	8	0.79
The Dental	Dental.	59,516	1	0.02
Saint Vincent's	General.	8,044	6	0.75
Prince Henry's	General.	9,980	7	0.70
The Queen Victoria	General.	7,713	1	0.13
The Children's	Children.	23,794	16	0.67
Total	..	193,977	89	0.46

(Note the low mortality at the dental hospital.)

TABLE XXX.  
Deaths of Patients Anesthetized with Ether

Hospital.	Number of Cases.	Number of Deaths.	Rate per Thousand.
The Alfred	9,388	5	0.53
The Royal Melbourne	18,962	9	0.47
The Women's	207	1	0.48
The Dental	27		
Saint Vincent's	5,842	3	0.51
Prince Henry's	9,315	2	0.21
The Queen Victoria	2,602	1	0.38
The Children's	23,035	10	0.43
Total	69,378	31	0.45

TABLE XXXI.

Fatalities in 10,119 Cases in which the Anesthetic Risk had been Assessed by International Anesthesia Research Society Standards.

Anesthetic.	"A" Risk.		"B" Risk.		"C" Risk.		"D" Risk.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Ethyl chloride	11	—	1	—	—	—	—	—
Ether	2,623	1	4,276	21	450	1	50	1
Chloroform	6	—	—	—	9	—	3	—
Nitrous oxide	89	—	280	—	2	—	58	—
Ethylene	99	—	424	—	612	—	108	6
Regional and local	44	—	44	—	31	—	24	1
Spinal	54	—	153	—	46	—	9	1
Various and unstated	67	—	205	—	34	—	8	—
Total	2,993	1	5,404	—	1,462	3	260	9
Mortality rate per 100	0·03	—	—	—	0·20	—	3·46	—

TABLE XXXII.

Deaths under Ethylene Anesthesia.

Hospital.	Number of Cases.	Number of Deaths.	Rate per Thousand.
The Alfred	1,453	7	4·81
The Royal Melbourne	481	1	2·10
The Women's	7	—	—
Prince Henry's	6	—	—
The Queen Victoria	91	—	—
The Children's	13	1	(78·9)
Total	2,051	9	4·4

TABLE XXXV.

Deaths under Regional and Local Anesthesia.

Hospital.	Number of Cases.	Number of Deaths.	Rate per Thousand.
The Alfred	8,314	4	0·48
The Royal Melbourne	15,361	3	0·19
The Dental	34,010	—	—
Saint Vincent's	698	—	—
Prince Henry's	211	1	4·7
The Queen Victoria	148	—	—
The Children's	173	—	—
Total	58,915	8	0·14

TABLE XXXIII.  
Deaths under Chloroform Anesthesia.

Hospital.	Number of Cases.	Number of Deaths.	Rate per Thousand.
The Alfred	75	—	—
The Royal Melbourne	176	1	0·57
The Women's	9,665	5	0·51
Saint Vincent's	35	—	—
Prince Henry's	3	1	(333·3)
The Queen Victoria	9	—	—
The Children's	17	—	—
Total	9,980	7	0·70

TABLE XXXVI.  
Deaths under Spinal Anesthesia.

Hospital.	Number of Cases.	Number of Deaths.	Rate per Thousand.
The Alfred	1,141	3	2·7
The Royal Melbourne	291	2	7·0
The Women's	3	—	—
Saint Vincent's	1,052	1	0·95
Prince Henry's	160	—	—
The Queen Victoria	15	—	—
The Children's	5	1	(200·0)
Total	2,867	7	2·62

[NOTE.—Mortality lies between that of ether (0·45) and nitrous oxide (5·6) in general surgery.]

TABLE XXXIV.  
Deaths under Nitrous Oxide Anesthesia.

Hospital.	Number of Cases.	Number of Deaths.	Rate per Thousand.
The Alfred	882	2	2·3
The Royal Melbourne	2,158	12	5·6
The Women's	89	2	23·0
The Dental	12,125	1	0·08
Saint Vincent's	359	2	5·6
Prince Henry's	172	2	11·6
The Queen Victoria	65	—	—
The Children's	533	4	7·5
Total	16,383	25	1·52

(Note the low mortality rate in dental work, in comparison with the high rate in general surgery.)

TABLE XXXVII.  
Deaths under "Avertin" Narcosis.

Hospital.	Number of Cases.	Number of Deaths.	Rate per Thousand.
The Alfred	11	1	(99·1)
The Royal Melbourne	41	—	—
Prince Henry's	3	1	(333·3)
The Queen Victoria	306	—	—
The Children's	18	—	—
Total	379	2	5·3

[NOTE.—(i) "Avertin" has been used almost exclusively as a basal narcotic; (ii) death occurred in cerebral operations under local anesthesia.]

## Reviews.

### OPHTHALMOLOGY FOR THE NEUROLOGIST.

THERE is no clear-cut line between many of the problems of the ophthalmologist and those of the neurologist. Therefore a book like "Neuro-Ophthalmology", which has just been published, should be of great value to both groups of specialists and indeed to the majority of physicians.<sup>1</sup> It is written by Dr. Lindsay Rea, who in his capacity as ophthalmic surgeon to the West End Hospital for Nervous Diseases, the Western Ophthalmic Hospital and the London Lock Hospitals, has ample opportunity of studying the different aspects of many of these problems.

After a description of the anatomy and physiology of the eye and the nervous structures associated with it, and of the equipment necessary for their examination, fourteen chapters are devoted to a study of the various symptoms and signs that may appear as signals of neurological and other disorders. Some of these chapters consist of a discussion of signs and symptoms such as papilloedema, optic atrophy and headache, while others treat of the affections which cause them. Although considerable attention is devoted to the views of other writers, many previously unreported experiences of the author are added. The bibliography, which comprises over forty pages, should prove of great value. The sections dealing with tumours of the optic nerve, syphilis of the nervous system, disseminated sclerosis and *herpes zoster* are excellent.

This book is well printed and contains 141 illustrations, many of which are coloured. It will prove a valuable addition to the library of anyone interested in the many and varied problems of neuro-ophthalmology.

### THE BILE.

THE liver has been spoken of as the most silent of organs; but its study has stimulated the flow of an overwhelming volume of words. H. Sobotka<sup>2</sup> is to be congratulated on the courage and industry with which he has attempted to collate the information contained in a portion of this vast and chaotic mass of literature, and on the measure of success which he has attained. Although his meaning is never in doubt, his use of words is sometimes unconventional, and he does not hesitate to coin them on occasion.

The author has wisely refrained from any consideration of the bile pigments in his review. These compounds are themselves the subject of an extensive literature and their adequate treatment would involve consideration of their relationship to the blood pigments.

His exclusion of the bile sterols is not so fortunate; but in this he has been the victim of circumstances. During the last few years a number of dramatic discoveries have been made in the group of the steroids. Compounds of this group have been shown to be of fundamental importance from a number of widely separated points of view. These discoveries have led the author to modify his original plan for the monograph, and to devote a separate volume to the chemistry of this group.

Strictly speaking, the bile acids should have been relegated to the other volume, as they, too, are steroids; but their consideration occupies nearly half the text of

the present monograph. Their structural chemistry is not discussed; but the information with regard to their distribution within and without the biliary tract and their various effects in the animal organism has been collected.

The rest of the book deals with the many substances and factors which have been shown to affect the secretion of the bile in one way or another.

Even with the restrictions which the author has placed on the material reviewed, over a thousand articles have been considered. The object of the monograph has been to present existing information rather than to discuss it critically. It will be valuable as a work of reference, in which many scattered quantitative and other data are collected, and as a guide to the literature of the subject. The originality shown in the abbreviations used for the titles of journals is to be deprecated. Authors should avail themselves of the standard "World List of Abbreviations" for their own convenience and that of their readers.

### MOTHERCRAFT.

A SECOND edition of "Mothercraft, Antenatal and Postnatal", by Dr. Reginald Jewesbury,<sup>3</sup> will be welcomed by physicians and nurses. The book covers a wide field and includes a chapter written by Professor J. S. Fairbairn on the relation of mothercraft to other aspects of maternity work, also a scientific discourse on the physiology of lactation by Professor J. Mellanby. Doctors and nurses will enjoy this book, but it is too full and too technical for the use of the untrained mother.

Although Dr. Jewesbury's sphere of work is in London, he uses almost exclusively the methods of feeding and training infants which were designed by the late Sir Truby King, and this volume could be regarded as a monument to the labours of the great New Zealander.

The author follows the usual example of writers on mothercraft by devoting the first chapter to the advantages and difficulties of breast feeding. He shows by charts from the Mothercraft Training Centre at Cromwell House how breast feeding has been reestablished as long as ten weeks after weaning.

The chapters on artificial feeding are based entirely on Sir Truby King's work, and the composition of all his milk mixtures is given in great detail. Many physicians nowadays introduce cereal feedings into an infant's diet much earlier than at the ten months suggested by Dr. Jewesbury, and Australian babies when weaned at the normal age of nine months would not be content with milk mixtures and a little vegetable purée.

The care of the premature infant is carefully outlined and the modern method of treating diarrhoea by the "apple diet" is described. The author does not use scraped raw apple, but stews the fruit and mixes it with saline solution and tea. He gives an excellent differential diagnosis of sugar, fat, and protein indigestion, a subject which is overlooked in most text-books.

The last few chapters deal with special diseases of infants and young children, for example, eczema, acidosis and marasmus. The one dealing with pyloric stenosis is particularly good. Although the author recommends the Rammstedt operation in most cases, he speaks well of the "Eumydrin" treatment. Careful and detailed diet tables are given. He condemns as unnecessary most circumcision operations and considers that separation of adhesions and dilatation of the prepuce are all that should be done in the vast majority of cases.

This is an interesting and well-written book, and the careful detail of all the menus, diets and feeding tables makes it invaluable for reference by those who care for infants, be they sick or well.

<sup>1</sup> "Neuro-Ophthalmology", by R. L. Rea, B.Sc., M.D., M.Ch., F.R.C.S.; 1938. London: William Heinemann (Medical Books) Limited. Crown 4to, pp. 590, with numerous illustrations and coloured plates. Price: 42s. net.

<sup>2</sup> "Physiological Chemistry of the Bile", by H. Sobotka; 1937. London: Baillière, Tindall and Cox. Medium 8vo, pp. 218. Price: 13s. 6d. net.

<sup>3</sup> "Mothercraft, Antenatal and Postnatal", by R. C. Jewesbury, M.A., D.M., F.R.C.P.; Second Edition; 1937. London: J. and A. Churchill Limited. Demy 6mo, pp. 197, with 21 illustrations, of which 13 are in colour. Price: 10s. 6d. net.

## The Medical Journal of Australia

SATURDAY, JUNE 11, 1938.

*All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.*

*References to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.*

*Authors who are not accustomed to preparing drawings or photographic prints for reproduction, are invited to seek the advice of the Editor.*

### THE ORGANIZATION OF ANÆSTHESIA.

THIS number of THE MEDICAL JOURNAL OF AUSTRALIA contains papers read before the Section of Anæsthesia at the fifth session of the Australasian Medical Congress (British Medical Association), held in Adelaide in August, 1937. It is the second number devoted to the subject of anaesthesia which we have published. The material included shows that the anæsthetists who met in Adelaide were enthusiastic students of their specialty, familiar with all the recent advances of this important department of medicine. It also reveals a healthy readiness of the members of the section to emphasize their failures rather than their successes. In this connexion the attention of the profession is directed to the tables relating to anaesthetic fatalities which form the greater part of this number.

With the object of determining the incidence, causation and prophylaxis of anaesthetic fatalities, a joint inquiry was undertaken by the Section of Anæsthesia and the Australian Society of Anæsthetists. Reports covering the past five years were obtained from most of the important hospitals of Australia and were presented in epitome at the meetings of the section. Since no survey on quite the same scale and the same lines has appeared, so far as we are aware, in the literature, we felt that

the full statistics of the individual hospitals should be placed on record. We have accordingly found space for them in this number.

A study of the reports shows that approximately one fatality occurred "on the table" in every thousand major operations performed in Australian hospitals. This mortality rate is not disproportionate to the character of the work and to the bad "risks" presented by many patients. Nevertheless the reports indicate that some fatalities were avoidable. The choice of anaesthetic agent or of technique was open to criticism in certain instances; in others the somewhat damning finding at autopsy was "no organic lesion to account for the patient's death". The reports will have justified their publication if they serve to remind readers of the cardinal requirements of safe anaesthesia, namely, an appropriate choice of drug and technique, a close observation of the patient's circulatory and respiratory condition, a competent use and maintenance of all apparatus and, most important of all, a rigid avoidance of anoxæmia.

Consideration of the reports also directs attention to the question of record-keeping. In some of the participating hospitals the records were so meagre as to be almost devoid of scientific value. Clinical experience may enrich the mind of the individual, but, unless properly recorded at the time, cannot be adequately transmitted to others. Further, clinical science suffers from a plethora of impressions and a paucity of recorded facts. We would therefore urge every clinician to keep the fullest records in his power. By this means he will be able to support his opinions with demonstrable facts and to accumulate a store of material for clinical research by himself and others. We would commend to the attention of those controlling the records departments of public hospitals the necessity for organizing the collection and correlation of all data and the advisability of presenting the correlated findings to the medical staff. Attention is called to the praiseworthy system employed at several of the hospitals, whereby every anaesthetic fatality is subjected to inquiry by an appropriate committee and the lessons learnt are circulated among all concerned.

It is perhaps regrettable that organized departments of anaesthesia similar to those of other lands do not exist in our hospitals. Tuition in anaesthesia at our universities and training schools is in the hands of men whose major preoccupation must be the earning of a livelihood by means of private practice. Such men, although capable anaesthetists and conscientious instructors, are amateurs in comparison with the whole-time teachers in overseas centres. The trend in Australian universities is to extend the curriculum in anaesthesia and to entrust the teaching to practising anaesthetists; but further progress will be limited while working conditions remain in their present state. Little organized provision exists in any Australian city for the post-graduate student desirous of improving his anaesthetic technique.

It follows that a dearth of original investigation in anaesthesia may still be expected from Australia. Research demands adequate facilities, unlimited time and economic security. The Australian anaesthetist, primarily engaged in private practice, can interest himself only secondarily in research. That he manages to perform a certain amount of original work is evidenced by the present number; but research in the physiological principles of anaesthesia is seldom possible to him. Rarely has a man the zeal, the physical energy and the disregard for financial considerations which enabled Embley to perform laboratory work of a high order whilst engaged in private practice. The anaesthetists of Australia, whose organization is still in its infancy, have attempted to carry out, in the reports here presented, a joint investigation of a statistical problem. We hope that they may shortly evolve working conditions which will enable them to attack along the same lines of concerted endeavour the more advanced problems of clinical and experimental anaesthesia.

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### Current Comment.

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#### THE DIAGNOSIS OF ACUTE APPENDICITIS.

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To see an article entitled "The Lucid Interval and Acute Appendicitis" is to have our interest immediately aroused, for we at once wonder whether

the author is referring to appendicitis in the insane. We can hardly believe that he refers to the mental state of the medical attendant. Perusal of an article with the above title by John O. Bower shows that by "lucid interval" he means the period preceding perforation of the appendix, with its inescapable sequence of peritonitis, during which signs and symptoms temporarily disappear.<sup>1</sup> The name "lucid interval" is borrowed from the corresponding hiatus in the clinical history of a patient suffering from traumatic extradural haemorrhage, and though the choice of English is questionable, the value of emphasizing the importance of this interval is undoubtedly. As the author remarks, a patient may be sent to hospital with a diagnosis of acute appendicitis, but on arrival apologizes to the hospital staff for his symptom-free state, and quotes the familiar parallel of the aching tooth which is cured by entering the dentist's door. We must further agree that if the surgeon accepts the diagnosis, perhaps largely on the history and on his confidence in the clinical acumen of the practitioner who saw the patient earlier, a catastrophe may be prevented. Bower traces the pathological history from the supposed obstruction of the lumen of the appendix either by a faecalith or by a mucopurulent plug through the successive changes in the mucosa and submucosa, with swelling and local necrosis, to the devitalization of the hitherto intact muscularis and serosa, and thence to rupture. He points out the all-important factor of intra-appendical tension in the causation of pain, and indicates the likely reasons for the cessation of pain. These are the devitalization of nerve terminals and the escape of gas and infectious material from the lumen of the appendix into the bowel, with a consequent reduction in vascular congestion. The action taken by a surgeon in this interval period is of the utmost importance. He can, of course, choose between two paths: that of immediate action and that of inaction. But if he takes the latter course, it is essential that he follow, at least for a time until observation has convinced him of the exact state of affairs, a routine similar to that laid down in the Sherren-Ochsner treatment.

Bower tabulates the points likely to be found helpful in the diagnosis of the pre-perforative stage of acute appendicitis. These include a complete history, a thorough physical examination, the careful evaluation of the findings of any other doctor who has examined the patient, and a differential leucocyte count. The history must include full information as to the amount of aperient or opiate which may have been administered, and the author quotes again the truism that colicky pain, at first central and later local, is still the most reliable early symptom of inflammation of the appendix. In discussing the second point he remarks that the significance of tenderness is not sufficiently appreciated by the average physician. We hope this statement is not true, but

<sup>1</sup> American Journal of the Medical Sciences, April, 1938.

the method of Murphy quoted by him might perhaps be more widely realized as a physical sign of value. This consists in light percussion on the bent finger over the suspected area. The last point, the making of a leucocyte count, is one not always applicable, and though the method is of great value, it must be remembered that the information it affords is only confirmatory. The author considers it of value in 80% of cases.

Finally the author calls attention to the high mortality of acute perforative appendicitis in the United States of America. Storey and others have pointed out a similar condition of affairs here. There can be no doubt of the great responsibility which the medical profession assumes in the diagnosis and treatment of this serious and common disease. A close study not only of the subject in theory, but of the patient in practice, is imperative.

#### THE SULPHANILAMIDE DRUGS AND PHOTOSENSITIVITY.

EVER since Domagk's paper in 1935, para-aminophenyl-sulphonamide ("Prontosil Album") and its derivatives ("Prontosil Rubrum" and "Prontosil Soluble"), along with many related substances, have been given extensive experimental and clinical trials and are at present in widespread use. Their efficacy in haemolytic streptococcal infections is now beyond doubt, and promising results have also been obtained in meningococcal, gonococcal, staphylococcal and in some *Bacillus coli communis* infections. But, as is usual when a wave of enthusiasm for a new remedy sweeps over the profession, there is at present a tendency to prescribe these drugs indiscriminately, sometimes in large doses, in almost any case of infection or fever. It is well to remember that these substances are by no means innocuous and can often cause serious toxic symptoms. These range from mild temporary disturbances, such as drowsiness, dizziness, headache and vomiting, to more severe manifestations, which include abdominal pain with persistent vomiting, acidosis, pyrexia, skin eruptions, anaemia, cyanosis, peripheral neuritis and even agranulocytosis. Cyanosis, caused by methaemoglobinæmia and sulphæmoglobinæmia, was observed soon after the drugs came into use. In a series of 106 cases of puerperal sepsis treated last year with sulphanilamide, L. Colebrook and A. Purdie observed cyanosis in 50%. Recently many cases of anaemia and a few of agranulocytosis have been described by G. Jennings and G. Southwell Sander. All this points to a profound disturbance of blood pigment metabolism and hematopoiesis, a suggestion which is supported by recent biochemical studies.

Many reports of cases of sulphanilamide dermatitis have appeared in the journals, the rash varying from a patchy erythema to maculo-papular and even vesicular lesions. But the most striking

point is the distribution of these skin lesions: they occur nearly always on exposed surfaces. In some cases the relation between exposure to sunlight and development of the rash has been unmistakable. This apparent photosensitivity after ingestion of these drugs led Brunsting in 1937 to search for photosensitizing substances in the urine. He found a definite increase in urinary porphyrins in two patients affected with sulphanilamide dermatitis. Further investigations along these lines have been made by C. Rimington and A. W. Hemmings.<sup>1</sup> These authors analysed the urine of a number of hospital patients undergoing sulphanilamide treatment. In nearly every case the urinary porphyrin was definitely above the normal value. This porphyrinuria was maintained for some time after withdrawal of the drug. A series of adequately controlled experiments was carried out on rats, rather larger doses of sulphanilamide than usual being used (0·4 to 1·5 grammes per kilogram). A marked rise in urinary porphyrin occurred in all groups of rats receiving the drug and was maintained for some time after its discontinuance. Estimations of urinary sulphanilamide suggested that excretion of the drug takes at least twenty-one days. Attempts to demonstrate photosensitivity of the treated rats were only partially successful. However, three of the animals developed typical cutaneous lesions after exposure to ultra-violet light. The urinary porphyrins were isolated and identified by crystallization and melting-point determination, and proved to be coproporphyrins I and III in equal quantities in human urine, and chiefly coproporphyrin III in rat urine. *Post mortem* examination of the rats showed little change except engorgement of the spleen and great deposits therein of stainable iron. These abnormal iron deposits were still present four weeks after stoppage of the drug.

The authors conclude that the sulphanilamide series of drugs exerts a deep-seated action on the hematopoietic system, probably by interfering with the incorporation of iron into protoporphyrin to produce haematin. Different proportions of coproporphyrins I and III are probably produced in different individuals, and as the series I pigments are more active this may explain the varied reactions to the drugs. The authors point out the similarity between the symptoms of acute porphyrinuria and the toxic effects of sulphanilamide. The fact that this treatment was at first applied only to patients in hospital probably explains the late recognition of the photosensitive effect. Newman and Sharlit are of the opinion that practitioners should warn ambulant patients against exposure to the sun during sulphanilamide therapy. Whether the porphyrins are responsible for all the toxic manifestations of these drugs remains to be proved; nevertheless, the suggestion is most interesting and serves as another reminder of the dangerous potentialities of this powerful but apparently two-edged weapon.

<sup>1</sup> *The Lancet*, Volume I, April 2, 1938, page 770.

## Abstracts from Current Medical Literature.

### DERMATOLOGY.

#### Warts.

MILTON A. COHEN (*Urologic and Cutaneous Review*, January, 1938) describes yet another cure for *verruca plana juvenilis*. He injects two or three cubic centimetres of a 3% solution of bismuth tartrate in water intramuscularly and directs the patient to paint the warts with "decolourised iodine" (United States Pharmacopeia). He states that the warts usually disappear in one to two weeks. He has found this method successful in cases in which bismuth injection alone, application of X rays and other modes of treatment have failed.

#### Alopecia.

LUCIUS F. HERR (*Urologic and Cutaneous Review*, March, 1938) discusses the causes and treatment of alopecia. He believes that although little can be done for advanced alopecia of the senile type, many patients with early alopecia, if treated efficiently, will show an appreciable growth of new hair. Individual hairs have a limited life span; they are shed from time to time and are replaced by new hairs, which grow out from the same follicles. If the rate of shedding exceeds the rate of replacement baldness ensues. Sibley estimates the duration of the life of the hairs of the head as two to five years, that of the eyelashes as 150 days. Congenital alopecia may be partial or complete, and is characterized by the lack of normal development of or even the absence of the majority of the hair follicles. Gillespie describes the occurrence of congenital alopecia in two girls and one boy of the same family, whose ages were between seven and twelve years. Acquired alopecia may follow fevers, syphilis, contact with metallic poisons such as arsenic or thallium, cachectic diseases such as tuberculosis, diabetes or rickets; or it may result from affections or injuries of the scalp, such as seborrhoea, burns, lacerations, furuncles, ulcerating syphilitides, kerion, favus, and so on. *Alopecia senilis* is mainly due to atrophy of hair follicles; seborrhoea may be a predisposing factor. The author observes that the exact causes of baldness are still in dispute. The factors involved may be endocrine, nervous, infective, circulatory or constitutional. *Alopecia areata* is believed by some authorities to be of psychoneurotic origin. The author describes the general treatment of alopecia, including in it the prescribing of appropriate diet, rest, exercise, fresh air, sunlight and properly fitting hats, as well as the administration, when it is indicated, of anterior pituitary gland substance, thyroid extract,

vitamins, iron, arsenic or liver extract. He considers that the use of anterior pituitary extract in the treatment of baldness is still in the experimental stage. He has found that thyreoid extract is frequently effective. He regards local treatment as of the utmost importance in this condition, and recommends the shampooing of the scalp once or twice weekly, followed by massage and treatment with the air-cooled mercury arc lamp, eventually to the point of erythema.

#### Pemphigus: Treatment with Sulphanilamide.

THE isolation of a streptococcus from the blood of patients with pemphigus was recorded by Welsh in 1934. In view of this finding, M. R. Caro (*Archives of Dermatology and Syphilology*, February, 1938) has administered sulphanilamide to two patients suffering from this disease. The first patient, a Jew aged fifty-two years, was being treated for *diabetes mellitus* when he developed the typical lesions of pemphigus on the trunk and head. Three weeks later, examination revealed many flaccid vesicles and bullae on a non-inflamed base, and many eroded and crusted lesions. Sulphanilamide was given orally in doses of 0.3 grammes four times a day. The patient's condition showed considerable improvement after treatment for one month. The second patient, a Jewess aged fifty-five years, had suffered from *pemphigus vulgaris* for about one year and had been under treatment for nine months. The usual forms of therapy had been used. The condition had been growing progressively worse, and at the time of examination the patient was nearly moribund. The entire cutaneous surface was covered by bullae, crusted lesions and large denuded areas. Fissures were present on the groins, and there was considerable oedema of the hands and feet. All other treatment was discontinued, and sulphanilamide was given by mouth in doses of 0.6 grammes six times a day, each dose being followed by 0.9 grammes of sodium bicarbonate. Applications of a jelly containing 5.0 grammes per centum of tannic acid were made twice daily. At the end of one week of treatment no new lesions had appeared, most of the eroded areas had healed completely, and the large crusted lesions were healing rapidly. The author admits that both patients may have had spontaneous remissions coincidental with the administration of the drug. But because the prognosis in pemphigus is hopeless he has recorded these preliminary findings, in the hope that the treatment may be tested more extensively.

#### Xeroderma Pigmentosum.

L. J. A. LOEWENTHAL AND H. C. TROWELL (*The British Journal of Dermatology and Syphilis*, February, 1938) describe the occurrence of *xeroderma pigmentosum* in three members of a family of African

negroes—a race which has hitherto been presumed to be immune from this disease because of the lavish amount of cutaneous pigment present in its individuals. Three brothers, aged eight years, three years and six months, and two years and six months respectively, had skins typical both clinically and histologically, of *xeroderma pigmentosum* with secondary carcinomata. The children were stated to be full-blooded negroes; consanguinity of the parents was denied. Keratitis was present in all three patients, and tumours of the tip of the tongue in the two older boys. The age of onset in all three children was about one and a half years.

A. M. H. GRAY (*ibidem*) showed a patient with *xeroderma pigmentosum* at a meeting of the Section of Dermatology of the Royal Society of Medicine. The patient, a youth aged eighteen years, had suffered from this condition since childhood. He remembered that the skin of his face and limbs had been freckled and had had warty nodules on it since he was seven years of age, and that at this age a nodule appeared on the left eyelid and fell off. A similar swelling had appeared on the left eyelid one year before; it had developed into a fungating tumour the size of a plum, completely occluding the left eye. There were about twenty other epitheliomatous growths of varying type scattered over the forehead, cheeks and chin. The patient was shown on account of these extensive epitheliomatous changes. The eruption otherwise had the ordinary characters of this rare disease. The skin, from the middle of the arms to the tips of the fingers, and from the middle of the thighs to the middle of the legs was studded with small brown pigment spots, and a great many warty keratoses were present. It was proposed to remove the greater part of the mass over the left eye by diathermy and to treat the growths by radium. The relationship between exposure to bright sunlight and the development of epitheliomata in this disease was discussed.

#### Sensitivity of Mucous Membranes and Skin to Oil of Anise.

ADOLPH B. LOVEMAN (*Archives of Dermatology and Syphilology*, January, 1938) records the case of a patient with stomatitis which was thought to be of "contact" origin because it was confined for the most part to the area surrounding the patient's artificial denture. The patient had a dermatitis of the left hand. Patch tests were made with material similar to that in the denture, with negative results. The denture itself was used in a test and it caused a strongly positive reaction. Patch tests performed with the cream used in cleaning the denture yielded a severe vesicular reaction. The ingredients of the cream were used for testing; the patient was sensitive only to oil of anise. Oil of anise contains 90% anethol; the patient was tested with anethol and

a severe reaction resulted. The stomatitis was reproduced by feeding gum-drops containing oil of anise. The patient was tested with several other essential oils and reacted severely only to the two which contained the anethol. Patch tests with oil of anise and with the denture cream were performed on many controls, with negative results. The author states that there has been no recurrence of the stomatitis nor of the dermatitis since the use of the denture cream was discontinued.

### UROLOGY.

#### Malignant Disease of the Testicle.

G. GORDON-TAYLOR AND A. S. TILL (*British Journal of Urology*, March, 1938) discuss the various aspects of malignant disease of the testicle. A simplified pathological classification of these tumours based on age incidence and prognosis is suggested. The relationship of injury to malignant disease of the testicle, and also the various clinical varieties of the disease are described. The occurrence of cancer in connexion with cryptorchidism is considered and the authors condemn operations designed in order to bring the imperfectly descended gonad into the scrotum. The results of various types of treatment of malignant disease are discussed. The method recommended is simple orchidectomy followed by deep X ray therapy. Seminomata offer the best prognosis, as they usually are more radio-sensitive than other malignant tumours of the testicle. Radio-resistant seminomata may be encountered.

#### Renal Calculus.

F. ALLBRIGHT (*New England Journal of Medicine*, December 30, 1937) records some of the conclusions arrived at after a year's work in the renal stone clinic of the Massachusetts General Hospital. He believes that no single factor is sufficient to produce kidney stones, but that a urine the composition of which is such that a crystallloid precipitates out is a factor in the formation of stones formed largely of that crystallloid. He advises that fluids should be given in large quantities to all patients with calculi, and states that dilution of the urine need not prevent it from being strongly acid. When cystine or uric acid stones are present the urine should be kept alkaline. The formation of calcium phosphate stones, in his opinion, may be caused by hyperparathyreoidism or other disorders of bone metabolism, by a diet rich in phosphates, by alkali therapy or by infection with urea-splitting organisms. In cases of hyperparathyreoidism the treatment is that of the underlying disease. In the treatment of most patients with phosphatic calculi an attempt should be made to render the urine acid by an "acid-forming" diet and by administration of ammonium chloride; it is

essential to test the urine to see that the desired acidity is obtained; the formation of stones may be increased by excessive calcinuria and phosphaturia resulting from acidosis. The author observes that infections with urea-splitting organisms are a common cause of alkalinity of the urine and of the formation of phosphate stones. An "acid régime", in his opinion, is not only ineffective but harmful in such cases. Neither acid nor alkali therapy is indicated in the treatment of patients with calcium oxalate stones.

#### Pyelography in Hydronephrosis and Nephroptosis.

BECAUSE there are many factors which influence drainage of the renal pelvis, R. B. Henline and L. Bray (*Journal of Urology*, December, 1937) consider that serial pyelo-ureterograms should be made in cases of hydronephrosis, nephroptosis and renal pain suspected of being neurogenic. They have observed that increased fluid intake accelerates the emptying time of the renal pelvis as estimated radiographically by the disappearance of contrast media. The authors state that they have not found any case in which they considered denervation of the renal pedicle advisable, nor do they advise operation in cases of nephroptosis without delayed emptying time. Their investigations were carried out on a series of one hundred patients from whom serial pyelo-ureterograms were obtained by Moor's method.

#### Vesico-Vaginal Fistula.

O. FRANCHE (*Journal d'Urologie*, March, 1938) concludes a study, published in three consecutive issues of the journal, of cases of vesico-vaginal fistula treated by Professor G. Marion in his public hospital practice. During a period of thirteen years ending in 1937 Marion operated on 95 patients with this complaint. In fifty of these, operation by the transvesical route was successful in 96% of cases. In 87.5% of twenty-four patients treated by the vaginal route good results were obtained. In the remaining twenty-one patients there was destruction of the vesical sphincter and also of part of the urethra. Such patients are the most difficult of all to treat, and many surgeons consider them incurable, confining their operative procedures to attempts at deviation of the urine. Marion's procedure is to close the floor of the bladder completely by attaching the free edge of the anterior vaginal wall to the subpubic soft tissues; a suprapubic drain is placed in the bladder and the patient is allowed to rest for about six weeks. The important second stage of tunnelling a new urethral canal immediately beneath the pubis is carried out by means of a boldly curved special trocar of large calibre. The internal opening is just behind the interureteric region and is determined by a finger in the bladder. A large boldly curved clamp is passed

from the bladder, following the curved trocar out to the vestibule as the trocar is withdrawn. The clamp is opened up in order to dilate the new canal, and is then made to hold a rubber catheter, which is drawn into the bladder and kept there until the new canal becomes "epithelialized". The suprapubic drain is maintained for about two weeks. The patient is allowed to urinate through the new channel when the suprapubic wound is healed.

#### Operative Procedures in Hydronephrosis.

W. C. QUINBY (*Journal of Urology*, December, 1937) describes two main clinical types of hydronephrosis: those due to congenital abnormalities of the kidney or appendages and those due to obstruction to the urinary outflow below. In the first group the author claims to have obtained successful results by plastic operative procedures when the abnormality was a vascular one; in these cases he prefers to perform uretero-pyeloneostomy. Ectopic and fused kidneys always present a special problem in each patient. The second group offers a less hopeful prospect of cure by plastic operation; the condition is frequently bilateral and accompanied by a severe infection. In these, correction of the hydronephrosis is secondary in importance to the removal of the underlying cause. If the latter can be achieved, the hydronephrotic kidney will often maintain a fair function and give rise to no symptoms, even though the pelvis is grossly abnormal. The author considers that every effort should be made to combat infection of the renal tract by oral and local antiseptics before any plastic procedure is undertaken. The mere provision of adequate drainage has not been sufficient, in his experience, to allay the infection. Intractable infection will spoil all efforts at plastic surgery. J. C. Sargent (*loc. citato*) mentions the frequency with which the structural cause of hydronephrosis is bilateral. This may not be evident when the patient first presents himself, but, in his experience, if nephrectomy is performed for hydronephrosis on a patient in the third decade of life, that patient often returns ten years later with hydronephrosis on the opposite side. In dealing with the evaluation of results he emphasizes the fact that hydronephrosis is characterized by periods of remission of symptoms, and deduces from this that freedom from pain after operation cannot be accepted as adequate proof of cure. The author's criteria of cure are: complete and permanent relief of pain accompanied, at a long interval after operation, by the finding of a substantial degree of anatomical involution, an amount of residual urine distinctly less than that which the actual pelvic capacity might comfortably tolerate, absence of or considerable decrease in the severity of infection, and a fair degree of function irrespective of the adequacy of the contralateral kidney.

## British Medical Association News.

### SCIENTIFIC.

A MEETING of the Victorian Branch of the British Medical Association was held on November 17, 1937, at Saint Vincent's Hospital, Melbourne. The meeting took the form of a series of clinical demonstrations by members of the honorary medical staff of the hospital. Part of this report was published in the issue of June 4, 1938.

#### Disseminated Encephalomyelitis.

DR. J. HAYDEN showed a male patient, a rubber worker, aged forty-seven years, who had been admitted to the hospital in August, 1937, with fever, diplopia and scattered neurological signs, which included evidence of bilateral pyramidal changes. He pursued a downhill course, became semi-comatose, and suffered from incontinence of urine and faeces. At that stage it was decided to try the intravenous administration of sodium salicylate, because of the success obtained with it in a previous case of encephalitis. The patient was given two courses, each of five injections; the dose was 0.65 grammes (10 grains) of sodium salicylate dissolved in 10.0 cubic centimetres of normal saline solution. After four injections the temperature commenced to fall. The general condition improved rapidly and the patient became brighter and quite conscious, the diplopia disappeared, and he recovered control of the bladder and bowel, but there was still evidence of pyramidal tract involvement.

Dr. Hayden remarked that a point of interest was that it had been suggested that the condition was due to carbon disulphide poisoning, as the patient had been employed in a rubber factory. Carbon disulphide could produce similar neurological findings, but it had been found that the patient had not been associated with the use of that chemical. The disease was regarded in his case as a virus infection of the nervous system. Another point of interest mentioned was the improvement resulting from salicylate therapy, which had been advocated for the condition by French physicians for many years. He had seen two patients make apparent improvement as a result of the treatment, and felt that as it was harmless it should be utilized in similar cases; but he made the reservation that the improvement might have been coincidental and not the direct result of the injections of salicylate solution.

#### Thyreotoxicosis.

Dr. Hayden also showed a female patient, aged thirty years, suffering from thyrotoxicosis, in which the original presenting symptom was pruritus. For three months before the thyrotoxic origin had been suspected she had complained of universal intolerable itching. On close investigation it was found that she had the more usual features of thyrotoxicosis, in the form of rapid pulse, tremor and sweating, and she had lost a little weight. The urine was sugar-free and the blood sugar level was normal. Dr. Hayden commented that though pruritus had been frequently reported in association with thyrotoxicosis, in his experience it had been a very uncommon presenting symptom. With rest in bed and the administration of sedatives and of Lugol's solution the patient's general condition had improved and the pruritus had ceased.

#### Cysto-Urethrograms.

DR. H. MORTENSEN demonstrated a series of X rays films illustrating the use that might be made of the cysto-urethrogram in the diagnosis of pathological conditions occurring in the lower part of the urinary tract. Stressing the possible dangers of cystoscopy in the diagnosis of prostatic enlargement, Dr. Mortensen showed that the mass of prostatic tissue and the type of enlargement could be accurately assessed from the skiagrams. The procedure involved as the maximum interference the passage of a rubber catheter. He stated that the solution used for the cystogram was a 4% aqueous solution of

sodium iodide, and the urethra was subsequently filled with "Hippuran Jelly" or "Neo-Hydriol".

Films demonstrating filling defects were shown in cases of bladder tumours, and it was pointed out that in that condition a more accurate estimation of the degree of bladder wall involvement was possible in many cases than by cystoscopy. The position, extent and character of a urethral stricture were shown to be easily demonstrable by means of the urethrogram. In many of the cases the presence of unsuspected false passages was of interest, one patient having been sounded for years through the false passage, to the exclusion of the normal urethra.

#### Bronchiectasis.

DR. S. BRAY showed three young patients suffering from bronchiectasis, and discussed the treatment of the condition. One female patient, aged eighteen years, had had bilateral pleurisy and pneumonia followed by whooping-cough in infancy, and later had had two more attacks of pneumonia with pleurisy. Throughout her life cough had persisted, and the sputum, which was yellow and fetid, amounted to approximately 170 cubic centimetres (six ounces) a day; it had been blood-stained only for a brief period during one attack of pneumonia. She had some pain on each side over the lower part of the chest, which was brought on by exertion. Though she had been in contact with tuberculosis, no tubercle bacilli had been found in the sputum. Coarse crepitations were audible at the base of the right lung, and by means of radioscopic investigation it had been established that there was irregularity of the diaphragm on both sides. This was considered to be due to pleuritic adhesions. The heart was not enlarged and there was no clubbing of the fingers. The nasal sinuses were of normal appearance radiographically. In October and again in November, 1936, lipiodol had been instilled into the bronchial tree, and in the subsequent films no bronchial dilatation could be seen; but some beading in the left lower lobe was present. In January, 1937, the patient was discharged from the clinic to her home, where postural drainage was continued until September, by which time the amount of sputum had been reduced to 30 cubic centimetres (one ounce) a day, but in the intervening two months had increased again to 170 cubic centimetres (six ounces) at the time of the meeting.

Dr. Bray's next patient was a girl, aged sixteen years, who had been under treatment for persistent cough following whooping-cough for two and a half years until she reached the age of seven years. The cough had returned recently and had persisted for six months before she came under treatment. The sputum amounted to approximately 280 cubic centimetres (ten ounces) daily and was offensive. At times she had complained of a feeling of stiffness in the right side of the chest, posteriorly. There was no history of contact with tuberculosis and no clubbing of the fingers. Coarse rales could be heard over the bases of the lungs and in the skiagram shown a great deal of "honeycombing" could be seen at the right base. By means of lipiodol the presence of bronchiectasis was established. She had been treated by means of postural drainage, and after three months the sputum had become reduced to 15 cubic centimetres (half an ounce) daily and was no longer offensive.

Dr. Bray's third patient was a young man, aged seventeen years, who for three months before he had come under notice had been coughing up yellow and fetid sputum amounting to about 115 cubic centimetres (four ounces) per day. The sputum was occasionally blood-stained. There was no history of contact with tuberculosis and no clubbing was present. Signs of cavitation had been found at the base of the right lung, and in the skiagram could be seen a triangular shadow in the right cardio-phrenic angle. The sputum had been searched repeatedly for tubercle bacilli, but none had been found. As a result of the lipiodol investigation the opinion had been formed that the left lung was normal, but that in the right lung there was collapse of the lower lobe, with cylindrical bronchiectasis. Dr. Bray stated that he recommended that this patient should be subjected to lobectomy.

**Lung Abscess.**

DR. W. J. NEWING showed two patients to contrast methods of treatment of lung abscess. One was a male patient, aged thirty years, who had been treated in hospital four weeks previously for pneumonia, the physical signs being mainly in the right axilla. The acute fever had subsided in a week, but coughing and increasing expectoration and low, irregular pyrexia had persisted. The presence of a lung abscess in the right lateral zone, quite close to the periphery, was established radiographically. There were no facts in the history that suggested the aetiology of the abscess, and tests for hydatid infestation were without result.

Dr. Newing's other patient was a man, aged twenty-five years, who a month earlier had suddenly coughed up a large quantity of offensive sputum which had settled in three layers. A large abscess close to the hilus of the right lung was detected by X rays.

Dr. Newing said that abscesses situated near the periphery of the lung were suitable for open drainage and usually responded well to treatment; he proposed to adopt that method with the patient he had shown first that night. He went on to say that the further the abscess receded from the periphery, the more difficult treatment became; abscesses in the middle zone were the most difficult. As the hilus was approached the abscess became more accessible to bronchoscopic drainage; that was the method of election in the other case. He remarked that as the abscess was very large and the general condition of the patient was low, it was doubtful whether closure would be effected. He pointed out that small abscesses near the hilus were often amenable to closure by artificial pneumothorax.

**Acute Bronchiolitis.**

Dr. Newing also showed a young man who was being treated in the hospital for an acute respiratory affection characterized by high fever, cough and copious sputum, with signs of widespread bronchitis over both lungs. He said that the sputum had been examined for tubercle bacilli repeatedly without result. He demonstrated in the skiagrams that a mottled condition was evenly distributed over both lung areas closely resembling the appearances of disseminated tuberculosis. In his opinion the condition was probably acute bronchiolitis of simple origin. He considered that in widespread tuberculosis with free sputum it was almost invariably possible to find the bacilli.

**Aneurysmal Dilatation of the Aorta.**

DR. T. DALY showed a female patient, aged sixty-five years, suffering from aneurysmal dilatation of the ascending, transverse and descending portions of the aorta. For five years the patient had had attacks of pulmonary oedema and had complained of weakness and faintness and shortness of breath. Previously her health had been good. The family history was satisfactory. She had not had any children, but had miscarried once at two months.

The apex beat of the heart was located in the sixth intercostal space, well out towards the axilla; the impulse was described as heaving, and in the aortic area it was noted that a thrill was palpable and the pulsation was visible. All over the precordial area a harsh systolic murmur was audible, and in the aortic area a diastolic murmur was also heard. In addition suprasternal pulsation was present. Interscapular dulness to percussion and evidence of deficient air entry to the base of the right lung were found. On the right side the systolic blood pressure was 180 and the diastolic 120 millimetres of mercury; on the left side the systolic pressure was 200 and the diastolic 135 millimetres. Hardening of the vessels was also noted.

By means of radioscopic examination while the patient was swallowing a radio-opaque preparation it had been established that the aorta was dilated and elongated and that there was not any pressure erosion of the oesophagus. Dr. Daly demonstrated by X ray films that the patient had aneurysmal dilatation of the ascending, transverse and descending aorta. He stated that the patient's blood serum had not reacted to the Wassermann test.

**Cerebellar Thrombosis.**

DR. DALY also showed a male patient, aged forty-two years, as an example of the clinical effect of thrombosis of a branch of the posterior inferior cerebellar artery on the right side. Five months before his admission to hospital the thrombosis had occurred suddenly, producing dizziness, blurred vision, headache and overbalancing. Later the patient became unsteady in walking, especially at night time, and had a tendency to fall to the right side. He also had diplopia, and his condition was gradually becoming worse over the period of five months from the onset. In 1915 he had had a chancre, and in 1917 he had suffered from malaria and had been treated by means of quinine. He was not addicted to alcohol.

On examination of the central nervous system it was found that neither optic disk showed any definite cupping, and that there were no scotomata in the visual fields; the pupils reacted normally to light and to accommodation; diplopia occurred when he looked to the left, the object being brought to the mid-line; nystagmus was present in each direction, but was coarser to the right. The seventh and eighth cranial nerves did not appear to be involved. It was thought that perhaps there was some hypersensitivity to pin-prick on the left side of the face. Slight dropping of the outstretched right hand and postural ataxia, affecting both sides, were noted. The tone of the muscles was regarded as subnormal, though the motor power was considered to be good.

The presence was established of relative left-sided hemianesthesia and hemianalgnesia and the tactile sensation was recorded as poor over the left upper limb. The sense of position, vibration sense and deep sensibility were within normal limits.

Examination of the patient's blood serum for syphilis by the Harrison method was reported as "negative" (warm) but partial (ice box). The patient was subjected to lumbar puncture on November 10, 1937, and the cerebrospinal fluid was found to be clear and under a pressure of 120 millimetres of water. It was examined by Dr. Brennan, who reported that the tests revealed no excess of globulin; the total protein content amounted to 30 milligrammes per 100 cubic centimetres; five separate tests for syphilis produced no reaction; there was no reaction to the colloidal gold test; and the cell content consisted entirely of lymphocytes, which amounted to only five cells per cubic millimetre.

**Some Results of Orthopaedic Treatment.**

DR. T. KING showed a number of patients to illustrate the end-results of some forms of orthopaedic treatment. Three patients had had adolescent *cossa varo* (slipped epiphysis) and had been treated by trochanteric wedge osteotomy with the apex opposite the lesser trochanter. All the patients showed evidence of some endocrine disorder, being either very fat or excessively thin and tall. Trauma was not a factor. Dr. King remarked that in the pure traumatic variety or even in the endocrine variety of *cossa varo*, if little softening and bending of the femoral neck had occurred, and if the patient was seen within a few weeks of the separation, reduction by traction or manipulation and immobilization in a plaster spica were good methods of treatment, provided weight-bearing was thereafter avoided for twelve months. Determined efforts, especially manipulation after a month or more, resulted in necrosis of the femoral head and in bony ankylosis; Dr. King had had such an unfortunate experience. In all severe cases X ray evidence was obtained of some unknown changes in the neck of the femur close to the epiphyseal line of the *caput femoris*. Weight-bearing then caused *cossa varo* bending and also anterior bowing of the neck, and finally complete separation of the head. This had occurred in one patient shown. The infantile type of *cossa varo* caused more changes in the femoral neck and less tendency for separation of the epiphysis. In two cases congenital *cossa valga* was present, although the separation of the epiphysis resulted in a *cossa varo* deformity; one of these two patients was shown.

Dr. King explained that the effect of the osteotomy, according to Pauwels, was to realign the cervical neck so that it was almost vertical, the shearing force on the

neck and head being thus converted into a pressure force, which favoured new bone formation. This was a reasonable procedure for the softened bone, and by its mechanical pressure ensured solidification and avoided *cossa varia*; after a year or more the upper end of the femur slowly approximated to the normal anatomical outline, the *caput femoris* being correctly placed on the proximal end of the femoral neck. Dr. King emphasized the necessity for adduction of the proximal fragment, which was ensured only by a large wedge osteotomy of 45° to 90°. He said that Schanz screws were objectionable because they always caused slight infection. He had abandoned them since in one ununited fracture of the femoral neck their use had caused a mild metastatic infective arthritis which had resulted in ankylosis of the hip joint. The adduction of the upper fragment was obtained by abduction of the limb to 90° or even to 120° to the long axis of the trunk. After the neck of the femur had been abducted as far as it would go, continued abduction of the limb closed up the wedge. When osseous union had resulted, the upper fragment was adducted in relation to the shaft of the femur. Dr. King remarked that the method was applicable in the severest cases, and function thereafter was good.

Dr. King then showed three patients who had suffered from recurrent dislocation of the patella; in two of these cases previous operations, Kroglius's and semitendinosus transplant, had failed. The patellae were then removed, with excellent functional and cosmetic results. Dr. King remarked that the procedure appeared to be a simple solution of a rather difficult problem.

Dr. King's next patient had had complete division of the flexor tendons in their osteo-fascial canals in three fingers; the injury had occurred five months previously. Function was good. Dr. King said that he had had other successes and that patients of this type could be satisfactorily dealt with provided infection did not supervene. The operation was simple. A tourniquet was used, but local analgesia should not be used. A long incision was made at the side of the finger from the distal finger crease to the distal palmar ridge; every structure, including the annular ligaments, was divided, except the vessels and nerves, especially where they separated at the necks of the metacarpals; the tendon was dissected. Dr. King pointed out that repair of the sublimis tendons was useless; they should be trimmed and cut short. Only the profundus tendon was repaired in each finger. If the proximal end could not be found, a short incision was made at the wrist. Shaggy tendon was excised until glistening tendon was found. If the tendon was then too short, it was lengthened at the wrist. Tendon grafts were to be avoided. The tendon ends were carefully sutured so that they would permit early movements. As a rule the finger was then flexed onto the palm, because so much unhealthy tendon had been removed. The skin incision only was sutured, and loosely; the various layers were not sutured. Suture of the skin was the most difficult part of the operation, because the finger was flexed, and Dr. King remarked that the operation at this stage appeared very unfinished. No splint was used. A sterile pad was placed in the grasp of the palm and flexed fingers, painted with "Matisol", and then around the hand as a whole, and bound on with a crêpe bandage. Although the fingers were fully flexed, there was no difficulty in obtaining extension later, provided adhesions did not develop. On recovery from the anaesthesia the patient was encouraged to make voluntary movements. The movements were necessarily slight at first, but by continuous voluntary movement the range was much enlarged at the end of ten days. Whilst early movements might sometimes result in failure of the tendon suturing, failure from adhesions was certain if splinting was used. The usual counter-irritation test with massage and heat was always used for detecting latent infection before operation. When more than one finger was involved, only one was operated upon at a time.

Dr. King's next patient had suffered for fifteen months from an ununited fracture of the upper end of the tibia; a cure was effected by means of a spongiosa graft, according to the technique of Matti, obtained from the

great trochanter. A previous operation of drilling and bone grafting had failed. Two months after the spongiosa transplant was packed, osseous union resulted. A suggestion had been made by another surgeon that the spongiosa graft should be used for ununited fractures of the scaphoid; since then Dr. King had performed such an operation. A tourniquet was used, and a transverse incision was made across the dorsum of the wrist. The dorsum of the scaphoid was exposed between the *extensor pollicis longus* and the *extensor carpi radialis brevis*. A gutter was made between the two fragments and the interior of the scaphoid was scraped out and packed with spongiosa bone. Dr. King stated that no end-result could be reported; Matti had, however, reported end-results of two cases in Number 41, 1937, of the *Zentralblatt für Chirurgie*.

#### NOMINATIONS AND ELECTIONS.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

Christie, Joseph, M.B., B.S., 1935 (Univ. Sydney), 80, Queen Street, Auburn.  
Johnston, Bristow, M.B., 1935 (Univ. Sydney), 261, Elizabeth Street, Sydney.

#### Correspondence.

#### PUERPERAL SEPTICÆMIA.

SIR: In THE MEDICAL JOURNAL OF AUSTRALIA of April 9, Dr. Lucy M. Bryce and Dr. Phyllis Tewesley published a detailed study of several cases of puerperal sepsis, dealing particularly with infection caused by haemolytic streptococci. This, together with your article under "Current Comment" in the issue of the 16th *idem*, concerning infections in general caused by these organisms, should be of interest to all concerned with the subject of maternal mortality. Authorities quoted indicated that about 20% of the normal population harbour haemolytic streptococci in their throats, and 7% are of the deadly Group A type. Your article stated that by reason of the fibrinolysin secreted by Group A and the absence of protective lymphatic thrombosis, little resistance to invasion of the tissues could be expected. Probably this accounts for the difficulty in identifying the site from which the infection spreads.

Of the 4,655 maternal deaths investigated in Great Britain, 790 were due to haemolytic streptococci following normal labour. Are there any proofs that such infection originated in the genital tract? It appears to be generally assumed that such is the case, that either at time of confinement or subsequently Group A streptococci were conveyed to the vagina from professional attendants or visitors.

After summarizing current literature, the above investigators enunciate two outstanding facts. I quote the second: "That, as evidence is accumulating that the upper respiratory tract of the patient herself, or more frequently that of her contacts, is the most probable source of puerperal infection with haemolytic streptococci (after either normal or abnormal labour) attention must be directed to possible methods of preventing transfer of organisms from these sites to the genital tract immediately prior to, during and after childbirth."

Is such transfer an assumption or is it proven? In the absence of convincing proof I feel it would be more correct and fairer to the attendants to regard such infection as we would any other streptococcal concurrent infection, such as scarlet fever or erysipelas. Probably the site of entrance is the throat, and apparently the puerperal state offers little resistance to streptococcal infections wherever arising. In general surgery some of us have had the

and glosa suggests such averse The sensor A with could two ergie. and disastrous results. Is it not possible that there exists a close analogy between this and the effect of labour and the puerperal state on a woman with Group A type already present in or subsequently conveyed to her upper respiratory passages?

The high percentage of contacts of the infected women (63% and 57%) whose upper respiratory tract contained organisms identical with those of the patients, indicates the menace that can arise from the nose and throat of puerperal septicemic cases.

The genital tract protects itself against the upward spread of the highly toxic puerperal ulcer unless conveyed thereto by the examining finger, and I feel that the droplet theory of infection and the necessity of using masks await confirmation. In the meantime it would be regrettable if the public and coroners (as reported recently in *The British Medical Journal*) were to hold the professional attendants culpable if masks are not worn.

I would be grateful for advice on this important matter, which would convince me that the genital tract is the site of origin of this disease.

Yours, etc.,

P. L. DANIEL.

West Wyalong,  
May 16, 1938.

#### NATIONAL HEALTH INSURANCE.

SIR: Now that the noise of battle has died down, let us review the position. Firstly, let us give all due honour and credit and the thanks of the profession to the gentlemen who gave of their time to visit Canberra and endeavoured to help the Government to place the National Health Insurance Act on a working basis. That their efforts were unavailing was no fault of theirs and they can retire with honour. It must indeed have been repugnant to them to have to adopt such huckstering and undignified methods; but it was necessary under the unpalatable circumstances.

There is no doubt but that the Government will have to make an offer that is less humiliating and less gratuitously insulting than what has been offered so far, and when that offer is made let it be accepted in a dignified manner, and let it be thoroughly understood that such offer will be placed before the members of the profession for their gracious consideration and possible approval.

Yours, etc.,

ALEX. A. LANG.

Penshurst Street,  
Willoughby,  
New South Wales.  
May 28, 1938.

SIR: The Federal Government, urged by an insatiable desire for higher levels of social reform, is unmindful that civilization is a complex "ring compound" metabolized by the fire of human effort, and that the safest methods of reform are effected by the introduction of measures which can be harmoniously adapted to present-day circumstances. Any attempts to stem the tide of human efforts in all departments of social service must be representative of the will of all sections of the community. The acceptance by medical practitioners of icosahedral systems of social service must lead to perpetual discontent, with a consequent lowering of both the standard of service and remuneration. Forced by the pressure of past economic conditions, the profession as a whole has accepted a menial system, guided in so doing by the highest motives, which lead us to a fuller understanding of those forces which make for human progress.

These and other factors have helped us in the establishment of a high ethical code having for its aim and objective

the betterment of the mental and physical characteristics of society.

A Machiavellian attempt has been made to force upon one section of society a system of medical service which can only create a condition of dependency, and at the same time denying the individual his right to contract, at his pleasure, with others for his employment. Treasure necessary for the adornment of such a system is not to be sought from one section of the community more than another. It is time when the fetters which have shackled all forms of liberty have rusted and some Pheidian love for the rights of the individual took a deeper root in the minds of those vested by the people with the authority to reconcile unity and coordination of effort in social, economical and political spheres.

The feudal lords of the constitution will not secure cooperation by the demanding the surrender of our individual or collective judgement under threat of gladiatorial combat or rhadamanthine justice; for the value of individuality and human personality has been recognized even in slaves and some mitigation of their lot demanded. Such an attempt to control even part of man's life and action compatible with his freedom in the advancing of any economic system cannot be done without safeguarding individual liberty, and must provoke a reaction against his unfettered liberty.

Governments and consultative bodies exist as such not by divine right, but by the pendulum swing of public opinion, and the will of the people in democratic countries decides who shall govern, and such contentious legislation has not had the sanction of all the people of the Commonwealth and should be submitted to them by referendum. Neither the Government nor the Federal medical council has consulted the general practitioner on the terms of any agreement reached between them, an action which seems contrary to reason. This is the position which confronts the general practitioner today, a position which threatens them with conscription.

Shall we as a body accept a reversion to the times of Charaka and Susruta and help in the publication of a second edition of the *Ayur Veda*, or spend our leisure moments rewriting the "Papyrus Ebers" on departmental forms? There must not be interference with the unrestricted rights of medical practice, a just and adequate remuneration for our services rendered to the community under any proposed system of national health service, adequate time for relaxation of mind and body, and some protection from the lash of officialdom.

Fetal legislation is endangered by abortion unless provision is made for the law of efficient interrelationship of its constituent systems. The lesson we have been taught by the British panel system has been one of the main incentives to Australian practitioners to safeguard their interests by demanding a national health service which primarily includes provision for the indigent poor of the community, and at the same time one which will be conducted on a very much more equitable foundation.

We must think gravely and carefully, and be of one mind, and not be guided by any temporary expediency or apparent self-interest; for what now may appear a reality may lead us to the quagmire of national suicide. The crows cannot be kept from the sheep by closing the gate on the farm.

Yours, etc.,

W. W. CAMERON.

Mudgee,  
New South Wales,  
May 28, 1938.

#### NOTICE.

We have been asked to announce that the Third International Congress of Tropical Medicine and Malaria will meet at Amsterdam during the period from September 24, 1938, to October 1, 1938. The general president of the congress is Professor G. Grijns, and the president of the malaria congress is Professor N. H. Swellengrebel. The fee for full membership of the congress is £1 and for associate membership 10s. Full membership entitles

the member to participation in the discussion and to receipt of the printed reports of the congress. Information may be obtained from the general secretary, Dr. Ch. W. F. Winckel, Instituut voor Tropische Hygiene, Mauritskade 57, Amsterdam O, Holland.

## Books Received.

**LEAGUE OF NATIONS PUBLICATIONS. ADVISORY COMMITTEE ON SOCIAL QUESTIONS: ENQUIRY INTO MEASURES OF REHABILITATION OF PROSTITUTES. SOCIAL SERVICES AND VENEREAL DISEASE; 1937.** Geneva: League of Nations Publications Department; Australia: H. A. Goddard. Demy 8vo, pp. 66. Price: 1s. 3d. net.

**SURGICAL ANATOMY OF THE HEAD AND NECK**, by J. F. Barnhill, M.D., F.A.C.S., L.L.D., with an introduction by P. S. McKibben; 1937. London: Baillière, Tindall and Cox. Imperial 8vo, pp. 936, with 431 illustrations, of which many are in colour. Price: 90s. net.

**THE MEDICAL ANNUAL: A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX**, edited by E. L. Tidy, M.A., M.D., F.R.C.P., and A. R. Short, M.D., B.Sc., F.R.C.S.; 1938. Bristol: John Wright and Sons Limited. London: Simpkin Marshall Limited. Demy 8vo, pp. 767, with 103 text illustrations and 68 plates, plain and coloured. Price: 20s. net.

**THE BIOLOGICAL STANDARDISATION OF THE VITAMINS**, by K. H. Coward, D.Sc.; 1938. London: Baillière, Tindall and Cox. Demy 8vo, pp. 235, with illustrations. Price: 12s. 6d. net.

**THE TROUBLED MIND: A GENERAL ACCOUNT OF THE HUMAN MIND AND ITS DISORDERS AND THEIR REMEDIES**, by H. Roberts, with chapters on the insanities by M. N. Jackson; 1938. London: John Murray. Crown 8vo, pp. 224. Price: 8s. net.

**YOUR BABY: A PRACTICAL GUIDE TO MOTHERS AND NURSES**, by M. A. Peck, S.R.N., with a foreword by V. Scantlebury, M.D.; 1938. Melbourne: The Woman's World Proprietary Limited. Crown 8vo, pp. 160, with illustrations. Price: 2s. 6d. net.

**ILLUSTRATIONS OF ANATOMY FOR NURSES**, by E. B. Jamieson, M.D.; 1938. Edinburgh: E. and S. Livingstone. Medium 8vo, pp. 64 (62 plates). Price: 7s. 6d. net.

## Diary for the Month.

- JUNE 14.—New South Wales Branch, B.M.A.: Executive and Finance Committee.  
 JUNE 15.—Western Australian Branch, B.M.A.: Branch.  
 JUNE 21.—New South Wales Branch, B.M.A.: Ethics Committee.  
 JUNE 22.—Victorian Branch, B.M.A.: Council.  
 JUNE 23.—New South Wales Branch, B.M.A.: Clinical Meeting.  
 JUNE 24.—Queensland Branch, B.M.A.: Council.  
 JUNE 25.—New South Wales Branch, B.M.A.: Medical Politics Committee.  
 JUNE 30.—South Australian Branch, B.M.A.: Branch.  
 JUNE 30.—New South Wales Branch, B.M.A.: Branch.  
 JULY 1.—Queensland Branch, B.M.A.: Branch.  
 JULY 5.—New South Wales Branch, B.M.A.: Council (Quarterly).  
 JULY 6.—Victorian Branch, B.M.A.: Branch.  
 JULY 6.—Western Australian Branch, B.M.A.: Council.  
 JULY 7.—South Australian Branch, B.M.A.: Council.  
 JULY 8.—Queensland Branch, B.M.A.: Council.  
 JULY 12.—New South Wales Branch, B.M.A.: Organization and Science Committee.

## Medical Appointments Vacant, etc.

For announcements of medical appointments vacant, assistants, locum tenentes sought, etc., see "Advertiser", pages xxii to xxiv.

**FREMANTLE HOSPITAL, WESTERN AUSTRALIA:** Medical Superintendent.

**NEWCASTLE HOSPITAL, NEWCASTLE, NEW SOUTH WALES:** Resident Medical Officer.

**THE WOMEN'S HOSPITAL, CROWN STREET, SYDNEY, NEW SOUTH WALES:** Resident Medical Officers.

## Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment referred to in the following table without having first communicated with the Honorary Secretary of the Branch named in the first column, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

BRANCHES.	APPOINTMENTS.
	Australian Natives' Association. Ashfield and District United Friendly Societies' Dispensary. Balmain United Friendly Societies' Dispensary. Leichhardt and Petersham United Friendly Societies' Dispensary. Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney. North Sydney Friendly Societies' Dispensary Limited. People's Prudential Assurance Company Limited. Phoenix Mutual Provident Society.
NEW SOUTH WALES: Honorary Secretary, 135, Macquarie Street, Sydney.	All Institutes or Medical Dispensaries. Australian Prudential Association, Proprietary, Limited. Mutual National Provident Club. National Provident Association. Hospital or other appointments outside Victoria.
VICTORIAN: Honorary Secretary, Medical Society Hall, East Melbourne.	Brisbane Associate Friendly Societies' Medical Institute. Proserpine District Hospital. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.
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